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and The AIRCRAFT ENGINEER

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The Outlook

——*Ad Astra*

THE description of the new Curtiss-Wright C-W20 in this issue serves as a useful reminder of one aspect of flying which is in danger, it seems, of being overlooked in this country. That there is little opportunity at present for fundamental research and experiment is too obvious to need stressing, and it may well be argued that we will attend to sub-stratosphere flying when the war is over and we can once more begin to use the aeroplane in the way in which the Wright brothers intended us to use it.

That is all very well, but there is much work to be done before the airtight cabin becomes a practical reality, and it is not very dignified—nor is it good, sound policy—to let others do the preliminary work and to step in when that has been done and go on from there. Let us benefit by the experience of others, by all means, but do not let us fall into the error that experience acquired at second hand is or can ever be a substitute for first-hand knowledge.

When war broke out at least three British firms were engaged on the design of airtight cabins. The Fairey commercial machine had been ordered, and the Fairey technical staff had done a great deal of preliminary work. General Aircraft had gone far with a private venture of their own and had accumulated very valuable experience. And Short Brothers had orders for commercial aircraft specifically designed for high-altitude flying.

It is to be feared that, unless the Air Ministry wakes up to a realisation of the importance of this kind of work, the subject of sub-stratosphere flying will be shelved for an indefinite period. Actually, a very good case can be made out for a programme of intensive development in this direction. It is not merely that it will be required immediately after the war (passengers will demand it as a right, to be spared the discomforts of changing pressures on their ear drums). There may very well be a wartime use for it.

It is known that Germany did a lot of research work on pressure cabins before the war. We should look rather silly if she quietly got together a couple of dozen high-flying bombers and sent them over London at some 35,000-40,000ft. Neither the present fighters nor the anti-aircraft guns would be able to take toll of them, and no great number would be required to maintain a daily raid.

That bombing accuracy would not be of a high order from that height is neither here nor there. The German High Command, if it decides to bomb London, will not be deterred by any difficulty of hitting legitimate military targets, and navigation within limits of a few miles would suffice to bring the bombers somewhere over the Greater London area. That would be sufficient for the *Luftwaffe*.

With the development of the airtight cabin would, of course, go that of the two-speed, or possibly two-stage supercharger, for the engines. But that problem is merely an extension of known practice, whereas pressure cabins for the crew introduces many unknown factors.

Escort Fighters

CONVOYING of merchant shipping at sea proved a great success in the war 1914-18, and it is already establishing its enormous value in the present state of unpleasantness. In the air we have not sufficient commercial traffic—more is the pity—to make convoying necessary. But the time may come when it will become necessary to escort our bombers on their long-distance flights. If Germany should start bombing inland centres in this country we shall have to retaliate, and in that case it seems doubtful if, even with their very healthy defensive fire power, the bombers will be

able to reach their objectives without excessive casualties.

In this issue we publish some speculations concerning the form which the escort fighter might take. There are several possibilities, and the merits and drawbacks of each of these purely hypothetical machines are examined in turn. For long-range work the most satisfactory type appears to be a machine similar in its main characteristics to a bomber and well supplied with turreted armament and ammunition. Such machines might fly as units in a formation and in company with powerfully armed bombers and would be able to put up a strong resistance to mass attacks by fighters.

Aircraft of the type in mind would require only the speed of the bombers to be escorted, but it would be advantageous to evolve faster long-range "turret" fighters, not primarily for escort work but for engaging raiding bombers at a distance from our shores.

New Power Plants

ONE of our readers has been so fired by enthusiasm after reading the articles by Mr. Fedden and Mr. Elliott that he has set to work on trying to visualise what future engine types may be required. His ideas are set forth on p. 39. It will be seen that he agrees with Mr. Elliott concerning the V-12 type of liquid-cooled engine for powers up to about 2,000 b.h.p., but that above this he considers the H-type liquid-cooled the most promising class. Here he disagrees with Mr. Fedden, who stated in his article that the problems of air-cooling the high-powered engine of H-formation were no greater than those of indirect cooling *via* a liquid.

Whether one agrees with our correspondent or with Mr. Fedden or with Mr. Elliott, the one thing which appears to emerge is that nothing like finality in design has yet been reached. While this fact may distress those who are thinking mainly in terms of mass-production, it will be welcomed by the serious student of aero engine design. Just think how dull it would be if we discovered that we could do with one type of engine in all our different classes of aircraft, merely by using one, two, three, four or even six of it!

Output

SOME interesting speculations concerning America's contribution to the aircraft production of the Allies are published in the latest issue of the New York journal *Life*. The author, Major G. F. Eliot, comes to the conclusion that something like a total of 4,000 aircraft will be built for the Allies during 1940. He bases his estimates on the best available American sources, and thinks that by the end of this year American aircraft constructors will have completed 1,530 military aircraft and 815 trainers for Great Britain. The corresponding figures for the deliveries to France are 1,660 and 370 respectively.

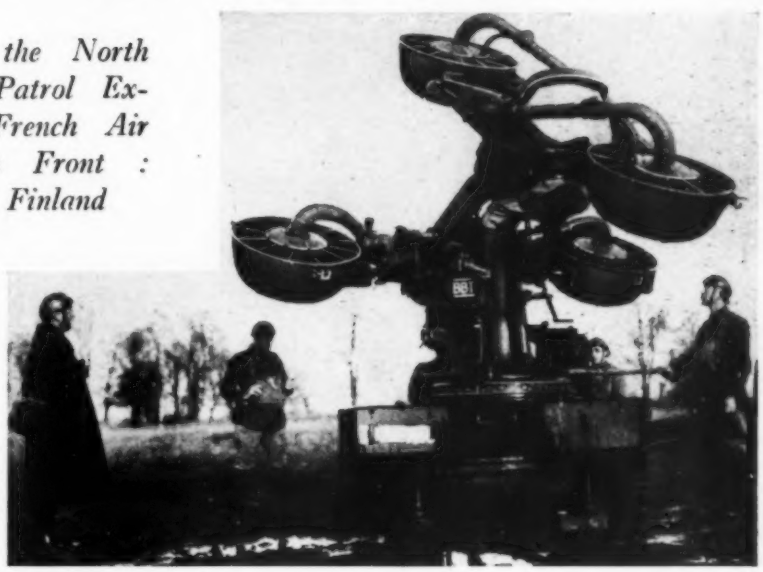
Major Eliot also examines the probable effect on the course of the war of these deliveries. Germany, he concludes, can only hope to win by establishing superiority in the air. The American contribution will not give the Allies superiority in numbers until the autumn of this year. Thus, he argues, Germany *must* make any stroke for victory which she intends to make in the spring of this year. Otherwise she will be too late.

While admitting that Major Eliot's figures may be somewhat in error, his estimates are probably not widely inaccurate. But he cannot possibly have any exact knowledge of the rate at which the Allies have increased their rate of production, and therefore his estimate of the exact time by which the Allies will have reached or exceeded Germany's production must be open to doubt.

PLEASANT SURROUNDINGS: Airspeed Oxfords flying over typical New Zealand scenery. An article on the Royal New Zealand Air Force appears on pp. f-h.

WAR in the AIR

More Activities Over the North Sea : The Security Patrol Explained : With the French Air Force on the Western Front : Foreign Aircraft in Finland



(Right) A modern French sound locator at work. The exact "balance" of sound in the four trumpet receivers betrays the position of enemy aircraft.

THE North Sea continues to be the centre of air activity. The operations of enemy mine-laying aircraft have shown a marked decrease since the institution of the R.A.F. Security Patrol, and there has not been any further reports of the bombing and machine gunning of fishing boats now air protection has been provided by the "Kipper Kites."

Hostile aircraft appeared over the Shetland Isles on January 1 and two bombs were dropped. The only casualties were three sheep. There were no hits on naval vessels nor casualties to their crews.

Dornier Survivors

IT is now confirmed that one of the three Dornier flying boats which were attacked by an R.A.F. Coastal Command aircraft on Wednesday, December 27, was definitely shot down. The three surviving members of the crew were picked up by the Swedish steamer Boden and landed at Kopervik, in Norway.

The German airmen stated that their machine had been hit about a hundred times, one of the crew being killed. They were adrift in the collapsible dinghy some eleven hours before being picked up. Another Coastal Command success was reported in an Air Ministry communication on New Year's Day—a good start. During the morning, 130 miles out to sea off the east coast of Scotland, three British aircraft encountered two twin-engined Heinkels. The enemy were engaged at once, and a running fight ensued for the next half an hour. The Heinkels when first seen were in line abreast at about 1,000ft., and one British aircraft, singling out the right-hand machine, scored many hits in the fuselage, engines and wings before the enemy pilot could manœuvre out of range. Almost immediately the front engine and both wings became a mass of flames, and the machine dived into the sea out of control. One of the crew attempted to escape by parachute, but for some reason or other, probably because he was too low, the drop was not successful, and he disappeared into the water.

The other Heinkel fared rather better but did not get away scot free. It was exposed to the concentrated fire of two attackers, and only able to escape by reaching a convenient cloud. Nothing more was seen of it.

The second day of 1940 brought news of further fighting over the North Sea. The bare announcement was, "There has been extensive air activity over the North Sea to-day and in the neighbourhood of the German coast. During the afternoon a formation of three R.A.F. bombers encountered a squadron of 12 Messerschmitt long-range fighters well out to sea. The formation, although heavily outnumbered, gave battle to the enemy. One Messerschmitt was shot down in flames, and two others were driven down and are likely to have been lost. One of the three bombers has returned safely; a second was shot down during the encounter; the third is missing."

Here is the story. The formation of three Vickers' Wellingtons was on a normal patrol searching for German warships at a point roughly 80 miles north-west of Heligoland, flying at about 10,000ft. in close formation, when the twelve Messerschmitt Me. 110 twin-engined long-range fighters made a sudden attack. The battle was at once joined, although the British were hopelessly outnumbered.

On his return the pilot of the third machine said, "We were going south when suddenly the look-out man shouted 'Fighters.' Almost before he had given the warning I saw streams of white tracer bullets flashing past on the port side. I then realised this was a serious battle. We had not seen the enemy because they came straight out of the sun. The first burst of enemy fire penetrated our fuselage but did no material damage. We gave as good as we got. We found ourselves fighting about twelve of the enemy single-handed. More bullets entered our aircraft, and some of them missed us by a few inches."

Six to One

FOR nearly ten minutes this aircraft fought its way out while no fewer than six of Germany's fighters made three dual attacks. The rear gunner got one and the front gunner claimed another. The rear gunners "bird" was seen to fall out of control, catching fire on the way down, and finally crashing into the sea still aflame, while the other victim was definitely hit, and was last seen in a steep spiral dive towards the sea. It is improbable that the pilot could have regained control. In the breathing space obtained by these two victories the pilot decided to seek the added protection of flying at sea level and dived from 10,000ft. to about 20ft. above the water. He was, however, immediately pursued by the enemy, and had to skim and dodge for some further thirty minutes before the enemy finally gave up the chase.

The Royal Air Force carried out reconnaissance flights over north-west Germany on the night of January 4. All our machines returned safely.

WAR IN THE AIR

There's a Long, Long Trail

MUCH puzzlement has been caused by so-called mysterious trails of white smoke appearing behind high-flying aircraft. This is neither exclusively German nor British. In moist layers of air during cold weather conditions the reduction of pressure immediately behind a machine causes condensation, and the effect of the exhaust gases produces what are known as nuclei formations. The clouds so formed are close to the aircraft and appear like "skywriting"; they are most voluminous when the machine is climbing

Mein Trampf

THE R.A.F. patrol off the German islands, sometimes described as the "Security Patrol," was designed to hinder mine-laying by enemy aircraft, and is thus the logical extension of the Royal Navy's famous Dover Patrol of the last war.

A patrol is carried out in the vicinity of the islands of Borkum, Norderney and Sylt, all of which have seaplane bases. Enemy seaplanes are, or rather were, accustomed to leave these bases just before dark, and every day our aircraft are there awaiting them. Relays of British bombers, each of which does five or six hours' flying, keep up the watch, sometimes combined with other work, and there can be no doubt that these patrols are effective.

The apparent nonchalance of the pilots' reports may be misleading. Adventure is dismissed with an impersonal line. "Patrolled and returned." "Over Sylt at 20.00 hrs. at 1,500ft.," is a typical one, and it gives no hint of the nature of the task. A sidelight on the type of men these pilots are may be gathered from this laconic statement in another report: "Subsidiary task: submarine sighted and bombed."

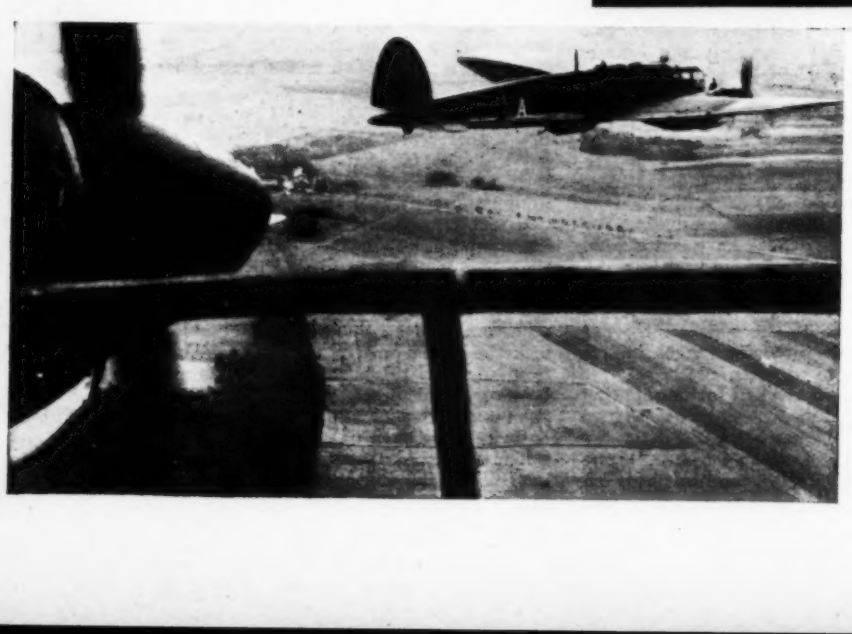
To appreciate their achievement it must be remembered that, though they are on defensive rather than offensive duty, they are no less open to attack. Their presence over the enemy's bases, hampering his activities and necessitating a strict and inconvenient black-out, cannot endear them to the Germans.

There is fire from pom-poms and from light machine guns mounted on hangar roofs. Our reply to this is necessarily restricted by the purpose of the patrol.

What our aircraft have to do is to force the mine-layers to stay at home, and this is one of the methods adopted.

The danger, however, is not only from men and their weapons. Like the aircraft that "sweep" the North Sea nearer home, the bombers of the Security Patrol have to suffer all the hardships and difficulties of weather. Nights have been dark so far, the sky grows darker and darker

(Above) The Dornier Do 18 flying boat is the type most commonly employed by the Germans for over-water reconnaissance and patrol. It is related at the beginning of this article how one of three of these aircraft was recently shot down by a machine of the R.A.F. Coastal Command.



(Left) A Heinkel He 111K of the newest type as seen from the pilot's cockpit of a companion machine. This type has already been employed by the Germans for bombing and, more extensively, for strategical reconnaissance.

NTINUED

(Right) The latest Merlin-engined version of the Armstrong Whitworth Whitley heavy bomber, which has done a vast amount of flying by night over Germany, has a redesigned nose as shown in this new *Flight* photograph. Its turreted armament is very powerful.

until towards the horizon it merges into the sea. There is the risk of occasional fog, even more unpleasant in the air than it is on the ground; and even at 500ft. there is the possibility that ice may form on the wings.

From the time our aircraft leave their bases until they return the crews are on the alert. That they are all men thoroughly trained in night-flying is a factor in their success, but it can hardly lessen the strain. "George," the automatic pilot, may help on the outward flight, but once arrived at the patrol area the pilot must have his eyes on the instrument panel all the time. Not only must he sweep the sky over the enemy bases, but in the neighbourhood of these German islands, which are close to Holland and Denmark, every care must be taken not to infringe neutrality. The observer, who is also second pilot, is continually checking the course, and the gunners have to be on the alert for enemy fighters.

What can be seen when our aircraft arrive off the enemy shores varies, of course, with the weather. On a fine evening the coast is fully visible, perhaps deceptively quiet, with the tide out and two or three seaplanes at moorings or on the slipway—though the enemy is growing less casual and confident now: he appears to keep his seaplanes indoors. Even in bad weather the darkness that is thick and impenetrable halfway across the North Sea is somehow less opaque near land. The sky may be overcast, but it is still possible to pick out the seaplane bases, and with a waxing moon conditions for the observer should improve, though the danger from enemy aircraft may also increase.

The strain is borne by the crews with a gaiety that almost gives the lie to it. Their secondary reports are full of grim humour and they set out—more or less from the mess-room lunch table now that night falls early—with a casual sort of air as though they were just going out for a stroll instead of a thousand-mile journey before bed-time. For tea, dinner and breakfast on patrol they depend on such things as hot coffee, barley sugar, plain chocolate, biscuits and raisins.

Aviation Militaire

NEWS from French sources is scanty, but the following two stories make stirring reading. It is learned that a Messerschmitt Me 109 has been forced down in this way.

One of our twin-engined machines was returning to its aerodrome after a photographic job done over German territory. Suddenly it was attacked behind with bursts of fire from four enemy fighters. Four hundred bullets were fired by the Germans without effect. Finding their attack ineffective, the Messerschmitts renewed it, but this time from the front. The sergeant-pilot replied, as did the gunner also, with the rear gun. Nevertheless, the fight was very one-sided until a patrol of three Morane-Saulnier 406s arrived and re-established the balance of forces. One Messerschmitt, hit by a French bullet, took fire and went down in a spiral dive and crashed, while the other three departed—"with understanding"—towards the east.

Our machine regained its base, where it was found to have been hit by fifty bullets in the fuselage and right wing. As for the three Morane-Saulniers, they continued their patrol to the end without encountering other adversaries.

The French Air Ministry has released the story of a mission accomplished by one of their twin-engined three-seaters, probably a Potez 63. The job consisted in going to photograph a certain region in German territory. After two tries the pilot had been forced to return by the effective defence. He succeeded in getting through on the third try and, having taken a hundred photographs, returned towards his base. Unfortunately his presence had been signalled, and while flying at 13,000ft. three Messerschmitt Me 109 fighters, which had been patrolling at 20,000ft., dived on him with machine-guns. The pilot, a lieutenant, was wounded in the shoulder; with one hand he continued to hold the control column, while the sergeant-gunner replied to the enemy.

The machine was approaching the lines when an incendiary bullet entered the right engine; this and its tank caught fire. With his machine in flames the pilot steepened the glide and arrived over French territory, where he landed in a field. He had only one thought—to release his observer—a lieutenant of infantry who, wounded himself, had fainted. Alas, he slipped, and, falling in a ditch, broke his ankle and also lost consciousness. Luckily, rescuers arrived and were able to release the three men, who are now well on the way to recovery.

On the Finnish Front

FINLAND continues to confound all expectations in their fight against Russia. During the past week bombing and leaflet raids have been made on the Soviet base of Uhtua and also over Pesel (in Estonia), Dagoe, Liinahamari and Leningrad, while the Russians have replied by bombing Aabo and the ports of Kemi and Hangoe. In the Aabo raid, apparently, incendiary bombs were used, and the famous castle dating back to round about A.D. 1300 was partially destroyed.

The week has been notable for the appearance of some fifty British aircraft and twenty Italian Savoia Marchetti machines which have been put at the disposal of the Finns by the countries concerned. There is also a report that four hundred American aircraft will reach Finland before the end of January.

Taking stock of the military situation after five weeks of war, the Finns claim to have brought down at least 150 Russian aeroplanes. America has remitted the remainder of Finland's 1914-18 war debt, and may make available for the purchase of war supplies a further £25,000,000.

AIRSCREW EFFECTS

A Subject of Increasing Importance

FOR his Wright Brothers Lecture, not to be confused with the Wilbur Wright Memorial Lecture, Dr. Clark B. Millikan had chosen the subject of "The Influence of Running Propellers on Airplane Characteristics." The lecture, which was the third in the series, was held on Saturday, December 16, this being the week-day nearest to the date of the event which these lectures are intended to commemorate, the first power-driven flight by the Wright brothers at Kill Devil Hill, North Carolina, on December 17, 1903. The first of these lectures was given in 1937 by Professor B. Melvill Jones, of Cambridge University, England, and dealt with flight experiments on the boundary layer. The second, on turbulence and the boundary layer, was given in 1938 by Dr. Hugh L. Dryden, of the National Bureau of Standards.

Dr. Millikan is a distinguished scientist and a fellow and past-president of the Institute of the Aeronautical Sciences, the American equivalent of our Royal Aeronautical Society. He is Associate Professor of Aeronautics at the California Institute of Technology at Pasadena. His many investigations there, dealing particularly with wind tunnel testing, wing theory, and aeroplane design, have resulted in notable contributions to the science of aviation.

In his lecture Dr. Millikan described the experimental and theoretical investigations undertaken at the California Institute of Technology during the past few years. He stated that it was early realised that running airscrews might have effects on aeroplane characteristics other than drag, such as on stability, control, flying qualities, etc. Results of scattered investigations of such questions began to appear at a relatively early date, but until fairly recently these secondary effects were generally of a minor character, so that the power-on characteristics could be estimated from the power-off or gliding characteristics by applying rough empirical correction factors.

In recent years, Dr. Millikan pointed out, this procedure had become increasingly unsatisfactory. Engine powers had increased, with corresponding decrease in power loading. Wing loading had increased spectacularly, and four-engined installations had become more widely used. The result was that a greater percentage of wing area was affected by the slipstream, and the velocity of the slipstream itself had greatly increased. The effect of slipstream, or, in other words, the difference between power-on and power-off flight, might often require serious modification in the overall proportions of an aircraft.

Dr. Millikan's lecture gave the results of a two-year investigation at the Guggenheim Aeronautical Laboratory, undertaken to ascertain the nature and magnitude of power-on effects. To mention but a few of the effects discovered: Stability was decreased; elevator effectiveness was increased; directional control depended upon the direction of the turn; the effect of one engine stopped on multi-engined performance was also studied.

The lecturer described the equipment used at the Guggenheim Aeronautical Laboratory. Models of about 7ft. span were generally used. They were equipped with small electric motors, capable of running up to speeds of 18,000 r.p.m., placed inside nacelles and driving model airscrews.

A theoretical analysis was given of the effect of power-on. This analysis had for its object to make available a systematic framework in terms of which the results may be viewed so that the data obtained will be of use in increasing our general knowledge of the phenomena involved; and also to give the aircraft designer some method of obtaining a rough preliminary estimate of the power-on characteristics of a new machine. Various parameters were defined which must be evaluated by wind tunnel tests.

In conclusion Dr. Millikan expressed the view that this particular field of research was one of the most important in contemporary design and would in the near future be the subject of intensive and widespread investigation.

Squadron Leader W. N. Cumming

SQUADRON LEADER W. N. CUMMING, D.F.C., F.R.Met.Soc., A.F.R.Ae.S., has now taken over command of No. 5 A.O.N.S. (Air Observer Navigation School) at Weston-super-Mare. The school is operated by Straight Aviation Training, Ltd., on behalf of the Air Ministry.

Sqn. Ldr. Cumming formerly served with the company in the capacity of Director of Training; prior to this he was with Imperial Airways for some time, and is the holder of a First Class Navigator's licence and a Master Pilot's Certificate for both land and sea aircraft.

American Barrel Engine

AN engine of unorthodox type has been designed by Aircraft Development, Inc., of Boston, U.S.A., and is receiving assistance from the Civil Aeronautics Authority who have recently issued a report on a two-hour test done on it. Known as the Alfaro, the engine is a two-stroke utilising the well-known but seldom-adopted principle of the swash plate. The four cylinders (bore 2 1/8in., stroke 3 3/8in. per piston) are arranged round the driving shaft with axes parrallel to it, and each cylinder has two opposed pistons like the successful Junkers Jumo 205 compression-ignition. The Alfaro is, however, a spark ignition engine with fuel injection.

The two swash plates are machined integral with the driving shaft, and piston thrust is transmitted to them through roiler bearings. Ports are holes in the cylinder walls, exhaust covered by one piston, intake by the other. Fuel injection is by Bosch pump at 2,000 lb./sq. in. and scavenging air (at a pressure of 6.5in. of mercury) is supplied by a centrifugal blower running at ten times crankshaft speed. Compression ratio is 9.5.

On 87-octane fuel, the engine developed 113 b.h.p. at 2,030 r.p.m., which corresponds to 132 lb./sq. in. b.m.e.p. The specific consumption of 0.59 lb./h.p.-hr. is not low. Dry weight is 2.34 lb./h.p to which the weight of the cooling system must be added. (This is not at all promising; better engines are already in existence, though maybe some weight refinements can be made on the engine tested.) Frontal diameter is low at 15½in., but radiator resistance must also be considered. The engine layout does not appear to be adaptable to air-cooling as the swash plates seem to prevent all chance of the air being led down the centre.

Death of Airship Pioneer

IT is with the most profound regret that *Flight* records the death in a nursing home at Winchester on January 3 of Capt. F. L. M. Boothby, R.N.

Born at St. Andrews, Fifeshire, Frederick Lewis Maitland Boothby entered the Royal Navy at the usual tender age. When airship work began in 1910 or 1911 he became a member of the experimental crew. In 1913 he was put in command of naval airship No. 4. Shortly after the outbreak of war in 1914 he was sent to Somaliland to report on the feasibility of air operations against the Mullah. For a time after his return he served in the armoured car section of the Royal Naval Air Service, and afterwards he specialised on airship work, serving at such airship stations as Barrow, Howden and Pulham.

Capt. Boothby became, and remained to the end, an airship enthusiast. He firmly believed in the value of airships, and it hurt him bitterly when first the Admiralty and afterwards the Air Ministry abandoned airship work. He regarded this as a calamity, and even the *Hindenburg* disaster did not shake his faith in the ultimate success of airships.

We on *Flight* had the good fortune to come into contact with Capt. Boothby on very many occasions, and even when we did not see eye to eye with him we always respected his specialised knowledge and his almost boyish enthusiasm. He had a smile which was the most disarming we have ever known. The passing of Capt. Boothby robs us of a valued friend, and to his widow, sons and daughter we extend our very sincere sympathy in their sad loss.

AND AFTERWARDS?

At the Risk of Accusations of Optimism, "Indicator" Thinks at the Beginning of a New Year of a Future Peace

WHILE preparing for a long war, and preventing oneself from visualising a return to normal times (which, one understands, is bad for morale), it is still pleasant to think vaguely about the likely effect of the war on private flying.

Other things being equal, I am absolutely certain that there will be much greater enthusiasm and support for flying. Aircraft manufacturers will, in any case, need to think a little more seriously of the civil market, and there are likely to be thousands of pilots who will not willingly give up flying.

Some may, reasonably enough, be sufficiently sick of it to wish to stay on the ground for good, but the majority will either retain their enthusiasm or be ready to obtain a special kick out of the idea of flying *without* the ever-present chance of being shot out of the sky.

Value of Danger

Furthermore, the average person will not suffer from what I have always considered to be an over-developed instinct of self-preservation. Not, at least, to the same extent. Go on living, by all means, but not at the expense of real enjoyment. If we really considered our lives before everything else we should never go out of our houses, and I am certain that you only really appreciate the fact that you are alive when at least a few little dangers have been survived.

Flying will never be entirely safe. Only those who stay firmly on the ground (and discuss academic points at Royal Aeronautical Society meetings) ever talk as if it will be. In fact, nobody really wants flying to be safe. All we demand is a freedom from unnecessary danger. We do not expect aeroplanes to come apart in the air and we hope that their little habits will not be too vicious. Viciousness is sometimes the price paid for performance and perfection of control—but it need not necessarily be so.

During the years before the present war life for the private owner and amateur became progressively more difficult. During the final twelve months it was difficult even to the point of being impossible for the ordinary pilot to proceed about Europe. Not only were prohibited areas continually being arranged and modified throughout central Europe, but there were endless minor regulations and the ever-changing political situation made it positively dangerous in certain areas.

The amateur, in fact, was practically kept within this country. Pleasant and useful (at least in the summer) as it can be to fly round and about the United Kingdom, the advantages of the flying machine are hardly being fully exploited in such circumstances. If you really *must* travel from London, say, to Manchester, it is much simpler to board a train, but if you must travel, for instance, to Prague, the aeroplane—whether one's own or an airliner—saves the most tremendous amount of effort and time.

In thinking of the future, one is between the devil and the deep sea of wish fulfilment. If the main war finished this summer, it is to be supposed that there would be a number of minor conflagrations still conflagrating and that Europe would, consequently, be no fit place for disorderly travel in small aeroplanes. If the war continues to the bitter and logical end both in Western and Eastern Europe then nobody will have any money. Also, the whole place will be in such a state of major dilapidation that, again, no private flying will be possible for years afterwards. The airlines will be restarted as a commercial and economic necessity, but the private owner (if any) will justifiably be treated as an intolerable nuisance.

In blacker moments I see only the next generation as enjoying and making real use of the air. When our war service is over, we of the present amateur generation will beg, borrow or steal all manner of scrapped aeroplanes for our summer holiday travel. Some of us will not be able to stay on the ground any more, and will wander over the world taking part in various wars or applying ourselves to any odd flying jobs which may be available. Others will settle down with a sigh (of regret or relief) to mundane jobs of work and will form flying clubs with any old aeroplanes which we can obtain at low prices.

Underwriter's Nightmare

There will be little or no direct justification of a subsidy—though I am certain that such assistance will amply repay any Government in the long run. Probably, for a year or two, we shall simply do what various pilots did after the last war—buy the equivalent of the old 504 with our gratuities and continue to fly as long as possible; or until the manufacturers come to life again.

Those, as I say, are the thoughts of blacker moments. We shall see. In the meantime, I am amused when I think of the fuss and bother occasioned when any one of us wanted to fly something a little advanced. Goodness knows what the insurance premium would have been for any one of the forty odd amateurs (who are at present flying *very* advanced aeroplanes with reasonable satisfaction) if he had been lent, say, a Douglas or Lockheed for a week-end. Yet, perhaps, I have little reason to be amused. Before one of them could be considered as fit to deal with such types he had to complete a conversion course at the Central Flying School which, though surprisingly short, would have cost anything up to £300 at a civil school. In an insurance underwriter's shoes I would have asked every penny of that sum before allowing "Indicator" to whistle round an aerodrome in, say, a Hampden or a Hudson. The economics are fair enough.

When, after this war, we approach "Lamps" for a special policy to cover all types, we can thank the British taxpayer for the fact that the premium will at least be appreciably lower than it would otherwise have been. The taxpayer pays for C.F.S. and receives very good value for it.

INDICATOR.

Canadian Woman Designer

THE Canadian Car and Foundry Co. have produced a new two-seater trainer known as the Maple Leaf. It was designed by their chief aeronautical engineer, Miss Elizabeth G. MacGill, who accompanied the test pilot on the initial flights. Holding a master's degree in aeronautical engineering, it seems that Miss MacGill is the world's first woman designer, although not by any means the first woman to work on the scientific and engineering side of aircraft work. There are several in this country who have served with distinction for some time.

A highly staggered biplane, with tandem cockpits, the Maple Leaf is very orthodox with a metal tubular fuselage and spruce wing spars. It is powered with a 145 h.p. Warner engine.

Boeing School of Aeronautics

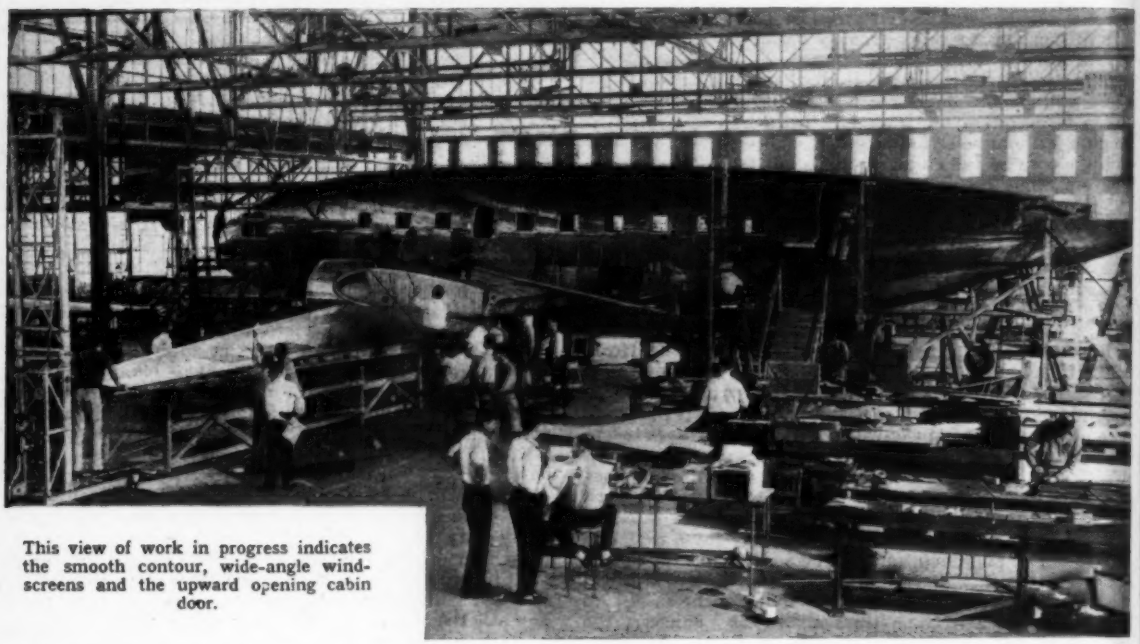
A NEW airline pilot course at reduced fees is announced by the Boeing School of Aeronautics. Taking 15 months, the course will cost 3,130 dollars. Requirements for admission are that the student shall have completed two years of "college" or the equivalent, shall be 20 years of age and in sound health. Students will be limited to 16 in each quarter.

Lockheed Expansion

LOCKHEED AIRCRAFT CORPORATION has bought another factory in Burbank, California, with a total floor area of 158,000 sq. ft. and 23 acres of land. This will be occupied by the Vega Airplane Company, a subsidiary of the Lockheed Corporation.

LARGEST TWIN-ENGINED CIVIL TRANSPORT

Curtiss-Wright, with 36-passenger Pressure Cabin, Nears Completion



This view of work in progress indicates the smooth contour, wide-angle windscreens and the upward opening cabin door.

NOW nearing completion at the St. Louis works of the Curtiss-Wright Corporation, the prototype 36-passenger civil transport designed with a pressure cabin will probably be test-flown this month. Formerly referred to as the "Curtiss-Wright CW20," the company now seems to have dropped this designation in favour of "36-passenger Substratosphere Transport." The fuselage is complete except for interior furnishing; wings, flaps and ailerons are attached, and the double-row Wright engines have been mounted.

The decision of the company, made some time ago, to build a transport of size intermediate between the sizes exemplified by the 21-passenger Douglas DC3 and the prototype DC4 to carry about 52 has been shown to be a sound one. The airlines have been so reluctant to order the 66,500 lb. DC4 that a contracted version of 50,000 lb. is going to be produced. Apparently, the estimates of traffic growth on the airlines in America were too optimistic, and caused a too sudden increase in aeroplane size.

New Features

Incorporating many new features in its design, this Curtiss-Wright will be the largest civil transport operating on two engines. Only since the development of the latest big engines has it become possible to design a 38,000 lb. 36-passenger aeroplane round two engines, a point in design which undoubtedly contributes towards piloting simplicity by reduction of the ever-increasing number of controls. The prototype is to have two Wright double-row Cyclone 14 engines which are rated at 1,600 h.p. for take-off, and the maximum speed so equipped is estimated at 243 m.p.h. But the latest Wright engine, the 18-cylinder Duplex Cyclone, about which information has not yet been released, may also be installed, and with its great power of something like 2,000 h.p. will add about another 30 m.p.h. to the top speed, as well as allowing the loaded weight to be increased to 43,000 lb.

The fuselage design is developed for pressure-cabin and freight-space considerations. The cross section is defined by the intersecting arcs of two eccentric circles, suitably faired at the re-entrant angle. At the intersection of the two circles the floor is attached, and provides the necessary tension member to resist the resultants of the tensile stresses produced in the rings of the fuselage by the internal pressure in the cabin. This design also has another advantage, in that it gives a cargo space large enough to be dignified by the name "hold," under the floor. Another compartment of 137 cu. ft. capacity is provided in the fuselage under the wing to take equipment such as batteries and tanks for hydraulic oil, de-icer fluid and water.

Fuselage Design

The fuselage near the wing is noticeably deep so that the hold is near the centre of gravity and big variations of trim are not caused by loading and unloading, which can be done through two large doors underneath the fuselage. The liberal depth of fuselage at the wing also allows the aerodynamic layout to be mid-wing (or perhaps "low mid-wing"), while still keeping the wing spar low enough to prevent interference with passenger accommodation in the fuselage.

The fuselage shape certainly appears to be both graceful and clean and it is said that the model tested by the Californian Institute of Technology gave the lowest drag coefficient for fuselages tested in their tunnel. The actual fuselage should have good skin-friction properties as flush riveting and flush cross-stream skin joints have been used. The makers also say that a relatively thick skin has been used to eliminate wrinkling. (As wrinkling occurs at a stress much below ultimate failing stress, it is sometimes necessary to use a plating of thickness greater than would be called for by ultimate failure requirements if excessive wrinkling under ordinary flying conditions is to be avoided.)

Low drag has also been sought by completely enclosing the undercarriage and the retractable tailwheel with flush

doors. It is noteworthy that the list of new features does not include the tricycle undercarriage.

The tailwheel type of undercarriage is fitted and this would seem to be a retrograde design step in this year of 1940. Blind-landing equipment and technique will improve and improve, but pilots will be happier if they can fly their aeroplanes on to the ground when visibility is bad. To do this it is necessary that contact with the ground shall not increase wing incidence, so tending to lift the aeroplane and cause a bounce, which is what happens with a tailwheel undercarriage. But the tipping forward of the tricycle type decreases incidence and lift and so tends to keep the aeroplane in contact with the ground.

Another necessity for blind landing is high-energy absorption in the undercarriage wheels, which in this case are designed for a descent of 800ft. per min. vertically and have a long travel. A welcome feature in undercarriage design is provided to ensure that no retraction is possible when the aeroplane is on the ground, not even when power is applied.

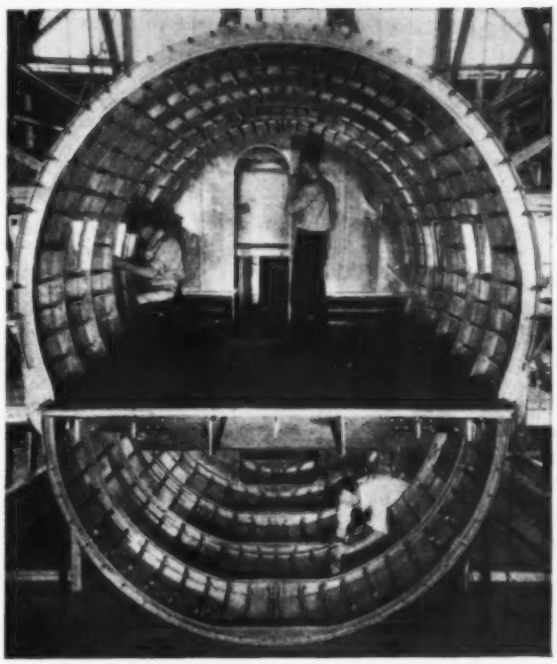
Wing and Tail Design

The wing structurally is of all-metal stressed-skin design with a single main shear beam and an auxiliary web. The skin, stiffened by hat-shaped stringers, carries both bending and torsional loads. Aerodynamically, it is claimed by the company to have good control characteristics and to be free from undesirable tip-stalling. The aerofoil section is NACA 23017 tapering to NACA 4410.5 and the wing is twisted to give some "washout" towards the tip.

Flaps extend from fuselage to aileron and are full trailing edge, slotted type. As the first of their movement is backwards, so increasing wing area, and then downwards, they can be used in an intermediate position for take-off as well as full down for landing, in which position a landing speed of 70 m.p.h. is estimated.

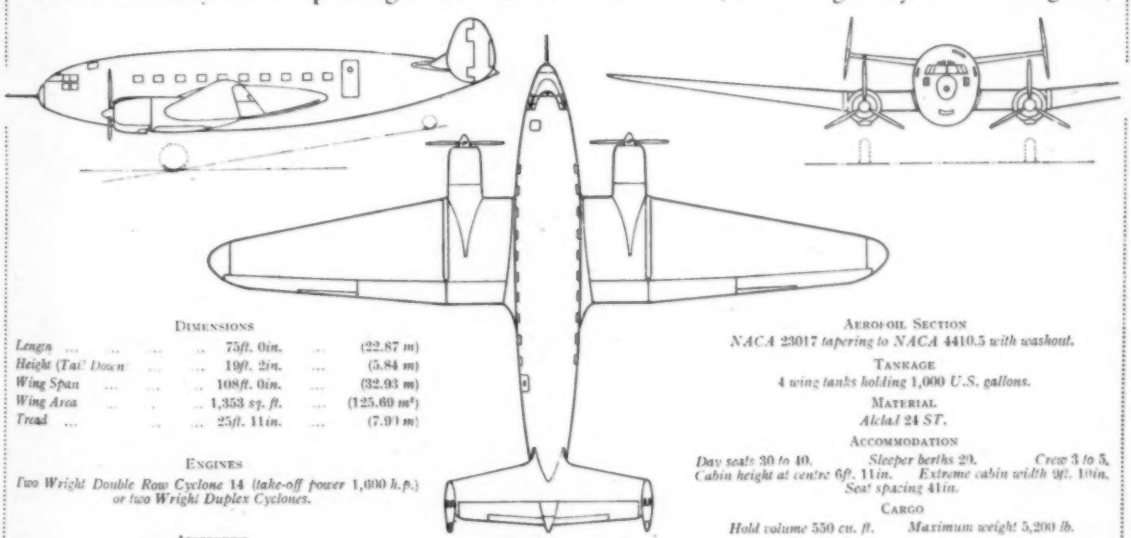
One glance at the tail shows it to be unusual in having dihedral on the tailplane and elevator—or should one say "elevators," for with this design it would appear to be impossible to incorporate that very desirable anti-flutter recommendation—that the two halves of the elevator shall be connected by a spar rigid in torsion. (Of course, a universal joint could be put in, but this would inevitably cause some reduction in torsional rigidity of the spar.) Two other unusual features are the high setting of the tailplane on the fuselage and the fact that the fins are not vertical, but cant in slightly.

The aspect ratio of the tailplane appears to be normal,



The Curtiss-Wright fuselage cross-section, showing how the shape is formed by two eccentric circles with the cabin floor at their intersection.

CURTISS-WRIGHT 36-passenger CIVIL TRANSPORT (two Wright Cyclone 14 engines)



Dimensions

Length	75*ft.* 0*in.*	(22.87 *m*)
Height (Tail Down)	19*ft.* 2*in.*	(5.84 *m*)
Wing Span	108*ft.* 0*in.*	(32.93 *m*)
Wing Area	1,353 *sq. ft.*	(125.69 *m²*)
Tread	25*ft.* 11*in.*	(7.90 *m*)

Engines

Two Wright Double Row Cyclone 14 (take-off power 1,600 h.p.) or two Wright Duplex Cyclones.

Airscrews

Curtiss constant-speed full-feathering electric type.

Weights

	Cyclone 14	Duplex Cyclone
Empty	24,750 *lb.* (11,227 *kg.*)	28,040 *lb.* (12,718 *kg.*)
Useful Load	13,250 *lb.* (6,010 *kg.*)	14,960 *lb.* (6,786 *kg.*)
Gross	38,000 *lb.* (17,237 *kg.*)	43,000 *lb.* (19,504 *kg.*)

Aerofoil Section

NACA 23017 tapering to NACA 4410.5 with washout.

Tankage

4 wing tanks holding 1,000 U.S. gallons.

Material

Alclad 24 ST.

Accommodation

Day seats 30 to 40. Sleeper berths 20. Crew 3 to 5. Cabin height at centre 6ft. 11in. Extreme cabin width 9ft. 10in. Seat spacing 41in.

Cargo

Hold volume 550 cu. ft. Maximum weight 5,200 lb.

Performance

	Cyclone 14	Duplex Cyclone
Maximum Speed	243 *m.p.h.* (390.99 *k.p.h.*)	273 *m.p.h.* (439.26 *k.p.h.*)
Cruising Speed	210 *m.p.h.* (337.89 *k.p.h.*)	230 *m.p.h.* (370.07 *k.p.h.*)
Landing speed	70 *m.p.h.* (112.63 *k.p.h.*)	74 *m.p.h.* (119.07 *k.p.h.*)
Rate of climb (at s.l.)	1,440 *ft./min.* (438.9 *m./min.*)	1,750 *ft./min.* (533.39 *m./min.*)
Single engine ceiling	13,000*ft.* (3,962 *m.*)	14,000*ft.* (4,267 *m.*)
Wing loading	28.1 *lb./sq. ft.* (137.24 *kg./m²*)	31.8 *lb./sq. ft.* (155.22 *kg./m²*)

but the fin and rudder, while not as stumpy as some that have been seen, could have been more liberally endowed with aspect ratio.

We have, in the last year or so, seen several large aircraft have their tail units redesigned completely after test-flying. At least three spring to mind at once—two American and one English types. Tail-unit design does not seem to be the strongest point of modern design and it will be interesting to follow the test flights of the Curtiss-Wright to see whether the unusual features prove successful.

Precautions taken against icing include the aileron design, which is so arranged that at no normal angle does the lower edge of the nose protrude below the under surface of the wing. The illustration shows that the usual "piano-type" American hinge has not been used. The flap mechanism, too, is protected against ice by being fully enclosed. De-icer "boots" on wing and tail surfaces are provided, and the Wright engines have the newly developed Chandler-Groves carburetter, which is claimed to be non-icing.

The matter of pilot fatigue, which is a significant item under the heading of safety, has been given considerable attention. The "Tell Tale" panel will help pilots greatly. By pressing a button for a certain condition of flight (such as Landing, Take-off, Climb or Taxi), the pilot is immediately told by an illuminated board what he must do. For example if it is Landing, the board reads, "Put down wheels, Wind in aerial, Light Fasten-Seat-Belt sign, Change to high-octane fuel," besides the numerous other odd jobs. (This feature was described and illustrated on page 205, *Flight*, March 2, 1939.) In addition, every effort has been made to reduce the number of instruments to the minimum needed for safe operation. The usual duplication of instruments essential to flight in front of both pilot and co-pilot has been adhered to.

Special efforts have been made to provide a clear view of the instrument board through the control wheels, which are said to be both hubless and spokeless. Pilot effort, too, is reduced not only by the usual tabs in the control surfaces, but by a power boost applied to the control system. In order to retain "feel" in the controls, a centralising spring is provided and is adjusted to neutral position by the tab control. Safety has also been sought by a special use of the gyropilot, which is so arranged that it comes in to give directional control in the event of failure of one engine in that critical period, the take-off.

The designers have provided a cabin atmosphere of 6,000ft. with aircraft operation up to 20,000ft. Pressures at these heights are 80 per cent. and 45 per cent. of sea-level pressure, so difference of pressure within and without the aeroplane will be 0.35 atmosphere (say, 5 lb. per sq. in.). No information is available on methods of heating, humidity control and deodorising to be used for the cabin air, or on the means adopted to make the fuselage airtight. The upward-opening door at the rear of the cabin is noticeable and is probably a design more adaptable to airtightness than the side-hinged type.

Thirty-six day passengers, with 20 sleeper berths at night, is the normal capacity, but with day accommodation reduced to 30, extra comfort is provided in the "club type." Seats are spaced 41in. apart. Sound-proofing is expected to reduce the noise level to 60 decibels. Indirect lighting, heating independent of the engines, accommodation for both steward and hostess, separate wash-rooms and lavatories for men and women and a fully equipped galley will ensure passenger comfort.

THOSE OVERSEAS MARKETS

By D. M. K. MARENDAZ, Capt. (late R.F.C.)

WITH reference to Mr. E. C. Gordon England's interesting article in *Flight* of November 30, 1939, I have been waiting for someone to back him up. However, as no one appears to have done so, I venture to offer the following account of my experience as an illustration of the manner in which the Government's words are translated in actions.

On September 7, 1939, Mr. Stanley promised in the House of Commons "to use every effort to ensure that the country's exporting capacity should be used to the best advantage," and "the Government trusted that the manufacturers and exporters in this country would, in the national interest, take the fullest advantage of all opportunities for export."

On October 24, 1939, we wrote to the President of the Board of Trade and asked for guidance, pointing out that we proposed to design and build an *ab initio* trainer, but that we understood that no aircraft of that class, which was not then in production, would be adopted. As an alternative, we proposed to produce our trainer for the overseas market, and asked the President of the B.O.T. for an assurance that the necessary raw materials (spruce and birch plywood, and a small amount of metal fittings and tubes) be available.

On November 27, having received no reply, we wrote again and reminded the B.O.T. of our previous letter. We then received a letter, dated December 5, in which it was stated that "enquiries were still being made."

A letter was written by us on December 7 to Mr. Stanley calling his attention to the fact that nearly two months had elapsed without our obtaining a decision, and that in the meantime the position had changed for the worse and it had now become necessary to get sanction from some department. We also pointed out the experience we had had with delays by the commercial secretary to the British Consul in Copenhagen.

At last we received a letter from the B.O.T., dated December 11, in which we were informed that "the Board understood from the Air Ministry that it was most improbable that the materials required for the trainer would be available, and that in any event difficulties were likely to arise with regard to the supply of engines."

I am informed by at least two officials that no trainer type of aircraft not now in use will be considered during the war. Yet we cannot be allowed, much less encouraged and assisted, to obtain neutral trade.

Mr. Gordon England and I have seen how our colossal expenditure in the United States enabled them to bring our vast motor industry, then the third largest, to poverty and despair. These same tactics are only too apparent at the present moment in the aircraft industry. There is home and/or world trade to be done at the end of this futile war. History will repeat itself in this industry.

An Opportunity

PERIODICALS and newspapers may only be sent to a number of neutral countries by publishers and newsagents who have a special permit. The publishers of *Flight* possess the necessary permit, and will be pleased to forward copies overseas on behalf of readers. What about a year's subscription as a New Year's gift to that friend of yours?

Indian National Airways

THE chairman, Mr. R. E. Grant Govan, C.B.E., of this company presented the annual report and accounts for the year ended June 30, 1939, at the general meeting held at New Delhi. The company, which operates between Karachi, Lahore and Delhi, and is in charge of the traffic organisation at the eleven Empire Air Service stations in India, made a nett profit for the year of Rs.69,012 (£5,200). This is Rs.22,366 (£1,680) higher than the preceding year and would have been sufficient to pay a 6 per cent. dividend on the preferred ordinary shares and a small dividend on the ordinary shares also. However, in view of uncertainty caused by war, the board recommended that only the preferred ordinary shares be dividend-bearing, this to be at the rate of 5 per cent., and that the balance be carried forward.

Rome to Tokyo?

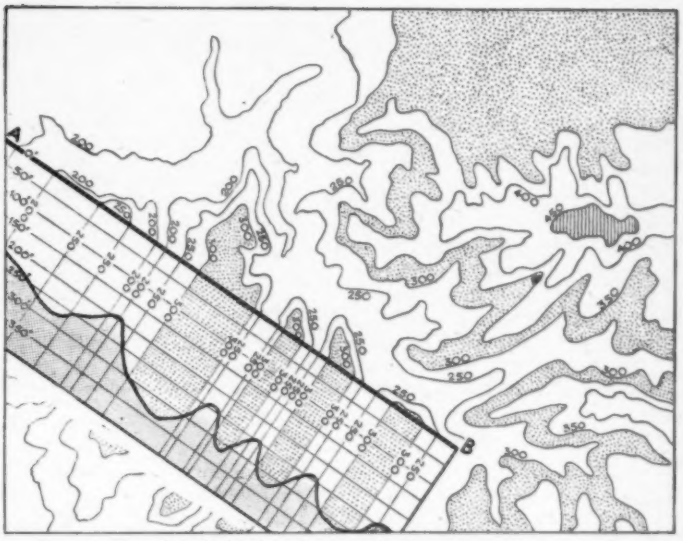
A JAPANESE aeroplane which landed in Rome on December 31 bearing greetings to Signor Mussolini is reported to be the forerunner of a regular service between Rome and Tokyo. As "A. Viator" points out, one should not assume too much.

THE ECHO ALTIMETER

Will Sonic Methods be Applied to the Air? Success of Sea Depth Sounding

By

FRANCIS CHICHESTER



How the record made by the echo sounder is used to trace a course on a given sea chart. A-B is the only possible course.

MARINE depth sounding has two interests for aviation. In the first place, flying-boat pilots must have their base harbours charted with great accuracy; and, secondly, sea sounding by sonic means indicates the lines on which height sounding in the air is most likely to develop. Some progress has already been made in this direction.

Marine pilots seldom require to know depths of less than 6ft., but seaplane pilots must have a chart showing all depths up to within 2ft. of the surface at low water and this chart of the sea floor must be exceedingly clear and accurate.

Lieut. Commander D. MacMillan, Southampton Harbour Board hydrographer, in his excellent handbook, "Precision Echo Sounding," describes in detail the instrument and method used to chart in a short time a large area of sea bottom to an accuracy of three inches.

Marine Echo Sounding

An echo sounder is fitted in a launch. It has a transmitter and a receiver provided with cone-shaped reflectors placed inside the hull near the keel. An alternating electric current is applied to a coil wound round a pile of nickel stampings in the transmitting cone. The changing magnetic field causes the nickel to expand and contract radially, a process known as magneto-striction. The frequency of the current is adjusted to make the nickel stampings resonate at their fundamental mechanical frequency, with the result that a pulse of high-pitched sound is emitted and reflected downwards by the transmitter cone.

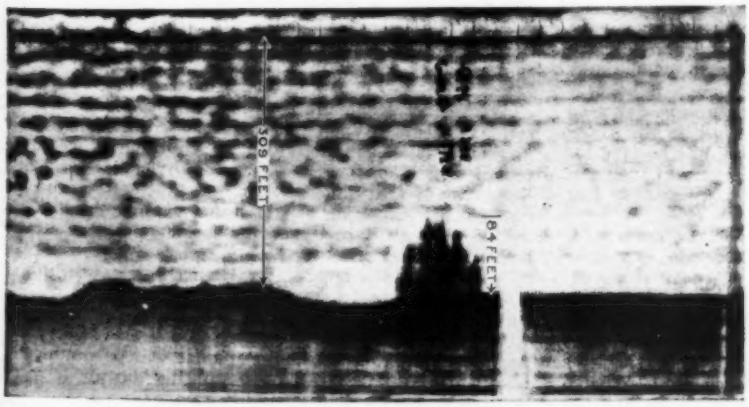
Scarcely affected by the metal hull it must pass through, the sound travels to the sea bottom and is echoed back to an oscillator in the receiver cone. The transmitting process is now reversed and a pile of nickel stampings is vibrated by the reflected sound waves and sets up a current in the coil, which current passes to a recorder.

Sound under normal conditions of temperature and water salinity travels at approximately 4,800 ft./sec. (about 3,250 miles per hour), and the problem is to measure the time interval between emission of the sound and reception of its echo.

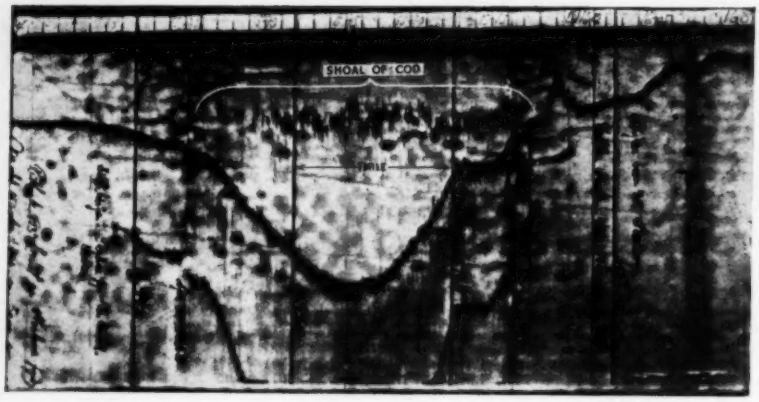
Accuracy to Inches

It is marvellous that a depth of a few feet can be measured to an accuracy of 3in. by such a method. Yet it is simple. A metal arm on the face of the recording instrument rotates at a constant speed. As it passes a certain point a contact is made, current flows to the transmitter and a pulse of sound goes out into the water. When the echo reaches the receiver the weak current generated is amplified and passes to the rotating arm of the recorder, finally discharging from the end of the arm to a metal plate. The plate is covered with chemically treated paper, which the electric current marks in passing through it. The longer it takes for the sound to reach the sea bottom and return, the further the arm will have travelled across the paper, and the further across the paper the mark will be. Thus, the depth at that instant is indicated. Meanwhile, the roll of paper is travelling downwards over the plate at a constant rate. Sounds are transmitted at intervals of a fifth of a second. Consequently, the depth is recorded on the moving band of paper five times every second

The sound is directed to the sea floor in a cone of 25° to 30° in width. The highest point in the area sounded will be the first to return an echo; so the least depth within the cone is recorded and at the end of a run the surveyor has a graph giving a continuous picture of the least depth along that strip of sea floor.



The wreck of the *Lusitania*, found after three months' work in 1936, shows clearly on this echo sounding record, which was used to locate her. Note how the sea bed has scoured alongside the wreck. The gap in the record is caused by the ship going astern and aerating the water.



The echo sounding system has been successfully used in the Norwegian fisheries for locating large shoals. This record was instrumental in directing a fishing fleet to a good catch.

Chart Making

The graph must be corrected before the true least depth below low water is determined. Allowance must be made for the state of the tide at the time of sounding. The depth of the oscillators below the waterline must be ascertained and the accuracy of the instrument checked.

This strip of sounded sea floor would be useless for chart making unless the launch's position everywhere during the run were known. This is an elementary exercise in surveying and is done by "transit" or "angle-fix" methods. In the first the launch position is determined by lining it up with two different pairs of posts erected on shore, while in the "angle-fix" method the two subtended angles between three landmarks are observed simultaneously by two navigators and provide data from which position subsequently may be calculated. So hydrographic charts may be prepared with "spot depths" shown all over them or with contour lines drawn to show depths.

Such a contoured chart would be very useful if the echo sounder record is to the same scale. For then a mariner wanting to know his position in a thick fog can detach the last mile of sounding record from the instrument and move it about the chart until its depth intervals exactly match the contours. This would give him his position with great certainty.

As well as its application for chart making, described above, the echo-sounder is used on ships to give a continuous and instantaneous measure of the depth of water beneath the ship's keel, and so is very valuable assistance to navigation, giving immediate indication of the approach to shallow waters.

Has sonic depth sounding an equally effective application in the air?

Sonic and Radio Methods

Every experienced pilot immediately appreciates what a tremendous life-saver, not to mention nerve-sparer, such a device would prove in the air. An aeroplane pilot's wireless may "pack up," or he cannot receive signals from ground stations; perhaps he has no wireless, or simply gets lost. He is flying blind in thick cloud or fog. He cannot remain in the air indefinitely; he must come down and make contact with the ground somehow. Is he over a hill or a valley? Is the cloud, mist or fog down to ground level? He may have to fly on until he hits something before he can find out. What wouldn't he give for a height sounder in such a predicament? And if it should happen to be night time as well, he would probably pay double!

Two methods of height sounding have been developed. An American system has a transmitter on the aeroplane which emits radio waves whose frequency varies rhythmically. The waves are directed downward to the earth and reflected upward back to the aeroplane. The time taken by the waves to travel to the earth and back gives a measure of the height of the plane above the earth. As radio waves travel at the same speed as light, 186,000 miles per second, it might seem impossible to measure the time taken for them to travel such a short distance as, say, 50ft. But this is achieved by measuring the difference of frequency between reflected and outgoing waves at the instant of reception of the reflected wave. The longer the wave has taken to be reflected up from the earth, the greater is the frequency difference to be measured, since the frequency of the emission is varying at a uniform rate all the time. In this way can height above ground be determined.

But Great Britain, France and Germany have developed *sonic* height sounders or, as they may be called, echo altimeters. These operate like the marine echo sounder, emitting a short pulse or sound and measuring the time it takes to reach the earth and return as an echo. The British instrument, developed by the same firm which makes the marine echo sounders, was ready for trial a year before the war started. Unfortunately, the Air Ministry has not yet seen fit to install it in a plane for testing.

However, the makers claim that it will record height above the ground once every second to an accuracy of 5ft. Height is recorded on a moving strip of paper in the same manner as with the marine echo sounder. A section of the ground beneath the aeroplane will therefore be recorded for the pilot to glance at whenever he likes; and when coming in to land, even if "blind," the angle of glide and height above the aerodrome will be available for the pilot's information till the plane is actually on the ground.

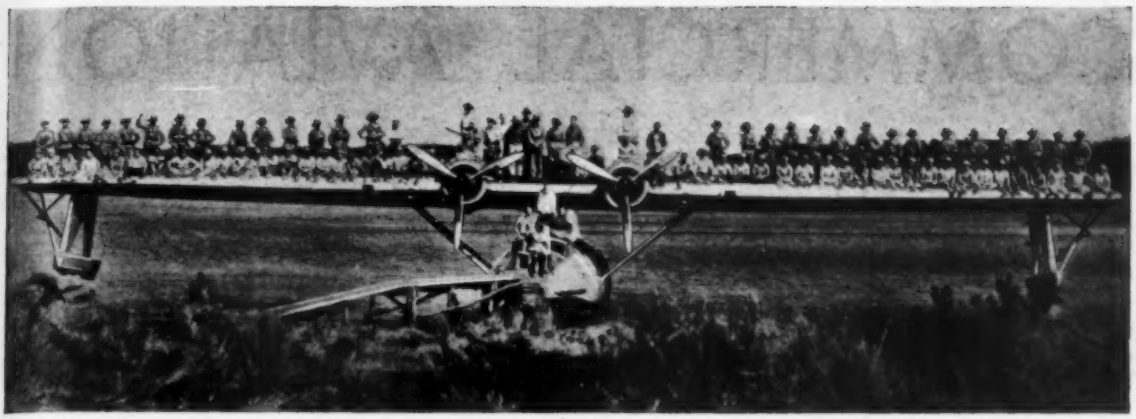
The instrument has a limitation. Sound travels through air at only about one-quarter of its speed through water, and air is a more difficult medium for it to traverse. The result is that an echo altimeter's vertical range is 500ft. over land and 1,000ft. over water. On the other hand, the echo will be positive and accurate to 5ft. The limited vertical range is not thought to be serious as it is near the ground that height determination becomes so vital; at higher altitudes the aneroid altimeter would still be in use.

Limitations of Radio Altimeter

For flying boats it will be of great value. For instance, on the east-west Atlantic crossing they often wish to fly as low as possible to escape the strong westerlies high up. What a relief to be able to fly within 500 or 1,000ft. of the water, whether at night or in cloud or fog, knowing all the time the exact height above the surface! And, at the end of the flight, to know the instant of leaving the sea and passing over land, would be valuable not only from the point of view of being aware of the reduction of available height, but also as a check on navigation.

The radio altimeter has the advantage of being able to determine heights up to 30,000ft. This, however, is not so important as accurate determination of heights from ground level to 1,000ft.; and the radio altimeter, or terrain clearance indicator as it is called, will probably have one serious defect. When over strata of certain substances having different conductivity and refractive indices it will record falsely as, for example, when over black soil overlying clay or a dry layer overlying a wet. Dry sand may not reflect radio waves at all, so they may be totally transmitted through it and reflected from a different stratum below. Furthermore, if there is a stratum of sand 30ft. deep, the altimeter recording will not only be 30ft. in error but five times that amount, owing to the slower speed of radio waves through sand as compared with through air.

However, the research into air sounding is yet young, and no doubt the perfect instrument will be produced as soon as information can be obtained from air tests and experiments.



"GUBA," the Consolidated flying-boat used by the Archbold Expedition. It is here seen on Lake Habbema at 11,500 ft. above sea level, apparently in use as a grandstand! On it are the members of the expedition with their Dyak carriers, skinners and hunters, cooks, personal boys and prisoners (who did the general labour of the camp.)

EXPLORATORY FLYING-BOAT

Experiences With the Consolidated PBY2 "Guba" in New Guinea

THE impressive photograph is of the "Guba" Consolidated PBY2 flying boat of the Archbold Expedition, which was lately in New Guinea doing exploration and collecting specimens for the American Museum of Natural History. Ninety-four men on the wing should weigh about 14,000 lb., and that certainly should not over-stress the structure, even in this "inverted flight case." We are apt to be unimpressed by aerodynamic forces until they are simulated by sandbags or live men. Actually, in a medium turn, fully loaded, the air forces on the wing of this craft would be about 30,000 lb.

The photograph was taken on Lake Habbema, the advance camp of the naturalists. This lake in the heart of New Guinea is at 11,500 feet above sea-level, with a corresponding reduction of density to 70 per cent. Eleven flights were made from Hollandia, the base camp, carrying men and food. The expedition tells us that on each trip the boat carried ten men, plus their baggage and gear and approximately 4,300 lb. of food, representing a payload of over 6,000 lb. per trip. In addition, there was the five-man crew, with emergency rations and gear of 100 lb. per man, representing a total of about 1,500 lb.

Lake Habbema is quite small and not conveniently shaped for landings and take-offs into the prevailing winds. The take-off was started down-wind, and the boat put up on the step and the floats retracted. Then, with floats up, power was reduced enough to make a complete turn while keeping the boat on the step, and then opened up for take-off into wind. The fact that the boat was taken off in 25 sec. with loads in excess of 21,000 lb. from this lake probably constitutes a world's record. (But the expedition has not told us what astronomical figures the boost pressure and revolutions reached in the take-offs.)

Designed as a naval patrol boat, the "Guba" was certainly a most suitable craft for the Archbold Expedition. And its equipment left nothing to be desired. As Lewis Yancey, the navigator, remarked when the boat was down in Melbourne for overhaul, "This is the only expedition I've been on when, if you wanted something, you only had to go and buy it." And Yancey showed the convenient and well-equipped chart table, with its prismatic drift-sight going out through the side of the flying-boat, so arranged that he could use it without moving from his seat. Then he related with a chuckle how he made a very sporting bet with the Simon's Radio-Guide people about the accuracy of their direction-finding apparatus, and, winning it, was presented with one of their instruments of the two crossed-pointers type. Yes, sir, that ship sure had everything, even a librascope

Mr. Archbold was no less fortunate in the crew he had—they matched the excellence of their equipment. Russell Rogers was in charge as chief pilot. It was this same crew which undertook the delivery flight last July of one of the latest Consolidated from the factory on the west coast of America to England, the longest delivery flight on record. In fact, the delivery flight was held up awaiting the return of the "Guba" after her Indian Ocean survey flight, performed on behalf of the Australian Government, so that Rogers and his crew might do the job. For it was this same boat which, with P. G. Taylor added to its crew and representing Australia, crossed the Indian Ocean in June last, so conquering the last big stretch of sea. Mr. Taylor is to be congratulated on achieving, with very suitable equipment and comrades with whom we know he is proud to be associated, something for which he has been striving for a long time.

Technical Diaries

VALUABLE for reference purposes and of increased interest at this time—when attention is fixed on technical subjects and allied hobbies—are the series of diaries produced by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Four of these diaries are produced under the auspices of their well-known journals, *The Amateur Photographer*, *The Autocar*, *The Motor Cycle*, and *The Wireless World*. Each is bound in leather cloth and, together with pencil, costs 1s. 6d.

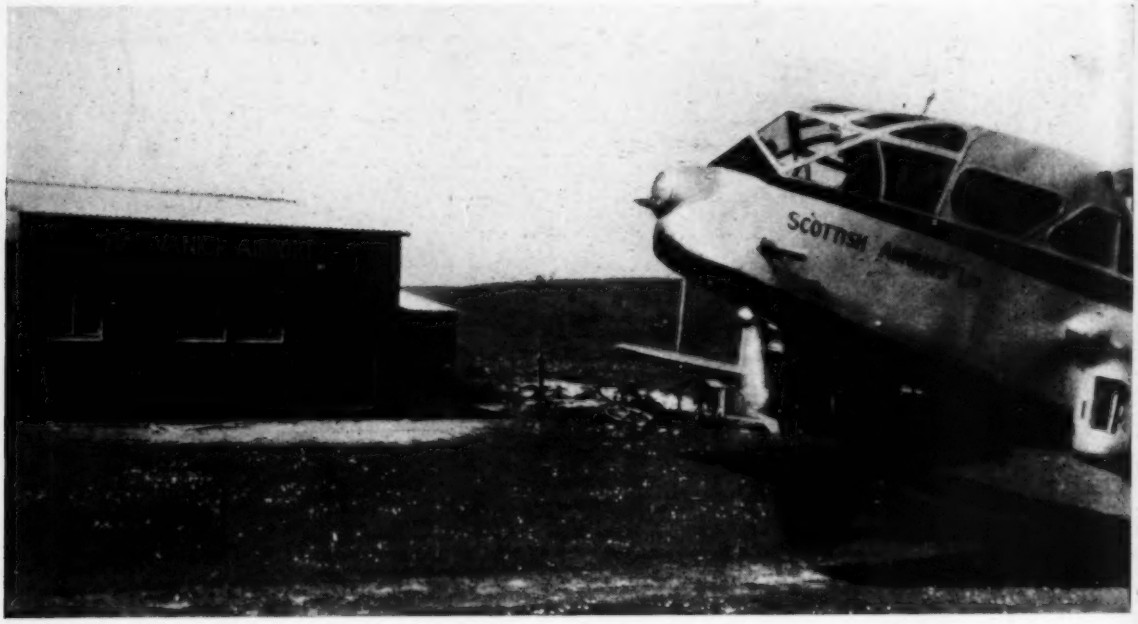
In each case the technical reference matter given amounts to over fifty pages, and includes many tables of formulæ and record logs, in which to note such items as exposures in the case of cameras and running expenses in the case of cars and motor cycles.

This Age of Speed

THE story is told by Qantas Empire Airways of the man who stayed the shortest time in Sydney. He arrived at Rose Bay base from Europe by Empire flying boat and explained to the traffic clerk that he had a passage booked to New Zealand on the s.s. *Tarawera* and asked when that ship was due to sail. "There's your boat," said the traffic clerk, pointing to a ship steaming serenely down the harbour . . .

In a few minutes that passenger was in a speedy motor launch, churning the blue waters of Sydney Harbour to white, and in a few more was alongside the steamer having his identity announced by megaphone to the bridge as ship and launch ran parallel. Then a door in the side of the liner opened and engulfed him, baggage and all.

COMMERCIAL AVIATION



PRIMITIVE BUT SERVICEABLE : The Airport building at Balivanich airport, Outer Hebrides. In front of it is one of Scottish Airways' Rapides with a somewhat unusual blister on its nose.

IT'S THAT MAN AGAIN!

"A. Viator" on Short-sighted Policy and Many Other Things

RECENTLY K.L.M., with an enterprise which is held down but by no means defeated by the war, staged a special flight from Amsterdam via an English Airport which shall be nameless to Lisbon via Madrid. British authorities were cordial and so were the Spanish. The Portuguese had already accorded permission, not only for the special flight but for a regular service, Amsterdam —Lisbon, if and when it should become possible to run one. The way of the pioneer is hard in wartime, however and in spite of the general benefits which would ensue from such a service, it is doubtful if the necessary permission for regular services would be forthcoming. A hint at the situation may be gleaned from the fact that it was necessary for K.L.M. to fly outside French territorial waters all the way, whereas permission was obtained to land in England, in Spain and in Portugal.

The flight was made with precision, without incident and in very good flying time, and the machine, a D.C.2., pilot and crew will remain in Portugal for the present.

Admiral Raeder and General Goering respectively, sent New Year messages to the German Fleet and Air Force and both quaintly enough referred to the glorious traditions of those services. Neutrals, such as American Air Force and Navy men, will wonder of just what these glorious traditions consist. Deliberate bombing of a trawler in order to spill the fishermen into the sea so as to machine gun them has become a cherished Nazi Air Force tradition I assume, and the parallel Nazi Navy trick of carefully selecting shrapnel to murder people in open boats after a submarine has sunk the steamer is another "glorious tradition" I suppose, to be enshrined in the annals of the harbour loving Navy of Nazi Germany.

Uncle Hermann again promises us an aerial onslaught such as has never been known in the history of the world. We do not rant and bluster about what our Air Force will do in return, but Uncle H. should know by now that it won't be exactly like sitting under an apple tree in spring with sweet scented petals showering down.

Meanwhile there is one cheery bit of news for the New Year chaps and I hope it is true. Some innocent Fritz out wild pig shooting saw the prize of a lifetime and let fly. It proved to be Uncle Hermann also out shooting and he was caught "whilst crouching in a stalking attitude, peering through the trees." As though that was not delightful enough in the way of New Year's news, the paragraph I saw continued with the remark that the wound was "only superficial." Well naturally a bullet which would have gone right through you or me, probably lodged in the fourth or fifth layer of fat and the Fritz concerned should in future carry his anti-tank gun when out after pork in those parts.

During Christmas celebrations at our airport, there was a French Air Force officer who had dropped in casually. Wishing to say something seasonable, a Britisher who had little French, suddenly raised his glass politely to the Frenchman and remarked "Bon Soir Monsieur."

The time was then 11.35 a.m.

Any movements which may be afoot to expand commercial aviation despite the times, scarcely seem to meet with the encouragement they deserve. Air France, I hear, now operates a regular air line from Marseilles to Lisbon via Lezignan, Oran and Tangiers, thus circumnavigating Spanish territory. This may mean that the Spanish Government will not allow French aircraft to land in Spain, or it may mean that France prefers to avoid Spain lest reciprocal rights to fly Spanish civil craft through France should be demanded.

It seems logical to assume that it has not yet been

possible for B.O.A. to obtain permission to fly through Spain to Portugal, otherwise a British service would presumably have started on that highly important link London—Lisbon. Whilst K.L.M. obtained Spanish permission to make one single landing at Madrid on the flight from Amsterdam via England to Lisbon mentioned above, I do not hear any news of Spanish permission being granted to the Dutch company for regular landings in Spain for a Lisbon service, although Portugal is sufficiently enlightened and intelligent to desire air transport to and from its capital.

France is at war and may be cannot afford to have neutral commercial craft flying around, but the case of Spain is otherwise. In that country the reconstruction would be helped by the air transport of other neutrals and even of belligerents, for Spain is not yet ready to run her own air lines and churlishness in granting permissions to others will not help her when she is ready. It never hurts a nation to let others operate before she herself is ready, and it is obviously easy to safeguard national aviation interests in the interim period.

Spanish civil aviation chiefs should remember that some twenty years ago there were neither trained civil pilots nor civil machines in Holland, yet Mr. A. Plesman, then as now the leader of Dutch civil aviation, did not mark time on that account. He hired British aeroplanes and employed British pilots whilst training Dutch personnel, so that when the first Fokker cabin machines were delivered, he was able to launch out at once. Nobody will maintain, I assume, that K.L.M. has suffered in any way by this procedure, or that Dutch national interests were in anyway injured.

News Editors, by the way, have an unconquerable habit of running before they can walk whereby many a pink, prehensile Fleet Street nose becomes flattened against brick walls. Just because K.L.M. sent one single plane to Lisbon a number of newspapers confidently assumed, without the slightest warrant, that a regular service had been or was about to be inaugurated.

Moreover, because K.L.M. by no means for the first time, proposes to send a plane to South Africa on a goodwill flight, newspapers promptly elaborated a regular Amsterdam—Cape Town service.

Whilst all the ridiculous flummery was in progress regarding the arrival in this country of a young Englishwoman from Germany, that section of the Press which was not at various sea ports being threatened with bayonets by the teeming hordes of soldiery who formed guards of honour, was disporting itself at our already all-too-congested bar for a couple or three days. We were of course, pleased to see the Press boys and so, incidentally, was the cash register behind the bar, for it is not their fault that their Editors send them around an such dam fool missions. In order to enliven their stop with us some of the less respectful amongst us organised a just-secret-enough disembarkation by stretcher—of a couple of great coats neatly rolled and placed under blankets. There was much clicking of cameras and whetting of purple, indelible pencils on white tongues, before the base deception was discovered.

I hear that Sabena, whose Brussels service has been doing remarkably well lately, has decided to operate a Sunday service as well as the normal week-day ones, in future.

A. VIATOR.

Australian Flying Doctor Services

THE report of the Victorian section of the Australian Aerial Medical Services for the year ended June 30, 1939, shows this life-saving activity to be as active as ever and furthermore financially sound. Victoria, being a compact state, has no need of medical services by air, so the Victorian people have taken on themselves the responsibility of maintaining a base at Wyndham on the north-west coast of Western Australia to serve the settlers in this outlying district. The aeroplane used is a DH Dragon owned by the MacRobertson Miller Aviation Co., whose Pilot Robinson is always on call to transport the medical man, Dr. Sweetman, over an area several times the size of England. The Dragon also does the airmail run between Wyndham and Daly Waters.

During the year under review, 32 return flights were made to give medical aid. The total cost of the service (including flying, depreciation improvements and office costs) was £2,800. Revenue was £3,000, made up from:—

Victorian donations	£1,600
Wyndham donations	£100
Patients' contributions	£150
Federal Government subsidy	£900
Sundries	£250
Total	£3,000

A.A.M.S. is actually registered under the Companies Act but is a non-profit-making company. All this shows the service to be soundly run with income slightly exceeding expenditure and is a magnificent example of the townspeople of a comparatively thickly populated part of Australia giving aid to outlying settlers who live about 2,000 miles away and whom they do not even know.

The above is, of course, only about the Victorian section. Other states run the bases at Kalgoorlie, Port Hedland, Alice Springs, Cloncurry and Broken Hill. Other medical aid not under the A.A.M.S. is available from Darwin where Dr. Fenton, employed by the Department of the Interior, is stationed, and at Ceduna on the coast of South Australia where Pilot Chadwick flies a Fox Moth for the Bush Church Aid, a Church of England organisation.

No Quarter-ounce Airmail Rate?

A POST OFFICE official has stated that there is no possibility of introducing a rate for quarter-ounce letters to South America. The present rate from Great Britain by the French airmail service is 5s. per half-ounce. The statement followed a request for a quarter-ounce rate of 2s. 6d., but the Post Office pointed out that, as many letters did not reach the half-ounce, quarter-ounce letters could not be carried for half-price as in most cases they would be right up to weight.

No doubt this is true, but 5s. is a lot for senders of private correspondence to spend on one letter, though not unreasonable for business firms. Could not a quarter-ounce rate at, say, 3s. be introduced?

Alderney Services Resumed

JERSEY AIRWAYS announce that regular services have now been resumed between Alderney and Guernsey, operating on demand on Tuesday, Thursdays and Saturdays. The time-table provides useful and convenient "through" connections for passengers travelling between Alderney and Shoreham or Jersey. Fares and charges are as follows:—

Airport to Airport only.	Single. s. d.	Return (valid three months). s. d.	Freight and Excess Baggage. per lb. d.
Jersey/Alderney (special "through" fare) ..	22 6	37 6	2
Shoreham/Alderney ..	75 0	125 0	5
Guernsey/Alderney .	15 0	25 0	1

Isle of Man Also

THE air service carrying both mail and passengers to the Isle of Man has now been resumed since the New Year.

The Storström Accident

THE report on the accident to the British Airways Lockheed Electra which caught fire in the air while flying on the Heston-Hamburg-Copenhagen route last August and descended on the waters of the Storström has now been made public by the Air Ministry. The enquiry was conducted by the Danish authorities, and the findings are agreed with by the Air Ministry Chief Inspector of Accidents.

Apparently petrol vapour, caused by overfilling of the tanks, probably at Hamburg, was present within the wing on the port side or in the cabin. This was ignited by some cause which could not be determined. Having brought the aeroplane down on the water, the pilot left the cockpit and swam round to open the cabin door and let the passengers out. Unfortunately, he was unable to do so, and the machine sank in four minutes. Four passengers and one member of the crew lost their lives. The pilot was later saved by a small boat and the aeroplane has since been raised.

SERVICE AVIATION

Royal Air Force and Official Announcements

R.A.F. Family Allowance Branch

THE Air Ministry department which deals with family allowances, dependants' allowances and allotments of pay of Royal Air Force personnel has moved from Ibex House, Minories, London, to Tetbury, Gloucestershire. All enquiries regarding payment of any of these allowances should be addressed direct to the Director of Accounts, Air Ministry (Dept. J.J.), Tetbury, Gloucestershire.

Foreign Secretary at Fighter Command

THE Foreign Secretary, Viscount Halifax, accompanied by Air Chief Marshal Sir Cyril Newall, Chief of the Air Staff, visited Headquarters, Fighter Command, R.A.F., on January 8. They were received by Air Chief Marshal Sir Hugh Dowding, Air Officer Commanding-in-Chief, Fighter Command.

Club Facilities

AMONG the many clubs offering facilities to the Services, the committee of the Stourbridge Golf Club, Ltd., Club House, Stourbridge, Worcester, have offered the use of their golf course and the amenities of the clubhouse to all members of the R.A.F. convalescing after active service.

Service Photographs of Germany

THE release for publication of more examples of photographs taken over German objectives by the R.A.F. is being considered by the Air Ministry. These should compare well with the German reconnaissance photographs taken over this country since the war and since published throughout the world. A member of the staff of *Flight* has been privileged to see them and confirms that they are of exceptional quality, some being taken from as low as 2,000 to 3,000 ft.

A.R.P. in India

ELABORATE air-raid precautions have been taken at the Marine Airport, Karachi, which, for the moment at any rate, would seem a far-sighted policy. Precautionary measures were commenced before the outbreak of war, which was just as well, as this foresight enabled sandbags and first-aid supplies to be purchased before the rise in prices due to the war. The price of sandbags trebled between September 1 and September 2. The A.R.P. consist of a refuge trench and two large camouflaged decontamination shelters. The Station Superintendent, who is air-raid warden at the Marine Airport, has conducted classes on aerial bombardment and gas warfare. Maj. Khan, I.M.S., has lectured on first-aid.

Australia's New Chief

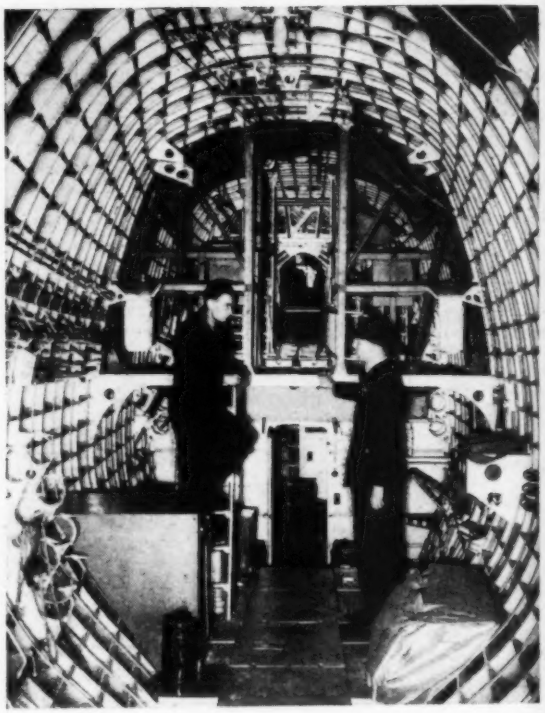
AIR Marshal Sir Charles Stuart Burnett, Inspector-General of the Royal Air Force, is to be the new Chief of the Australian Air Staff, it was announced by the Prime Minister, Mr. R. G. Menzies, in Melbourne a few days ago.

This follows the resignation of Air Vice-Marshal S. J. Goble, who had been appointed acting Chief of the Air Staff during the absence in England of Air Vice-Marshal Williams. Air Vice-Marshal Goble will not resign his commission but has been granted special leave pending an appointment abroad. Air Commodore Anderson will be acting Chief until Sir Charles arrives to take up his duties. Air Commodore Russell, who has been in Australia on exchange, will immediately return to England and his place will be taken by Air Vice-Marshal Williams, who will return as member for personnel or in charge of training under the Empire Training Scheme. Air Vice-Marshal Williams's trip to England occurred subsequent to the report of Sir Edward Ellington on the R.A.A.F.

Mr. Menzies, in expressing the gratitude of the Australian Government to the British Government for the appointment of Sir Charles, said that the enormous expansion plan involving the training of 26,000 air personnel was a task so great that it required the services of commanding officers of pre-eminent experience abroad.

The news of Air Vice-Marshal Goble's resignation will be received with regret by the many who know him. Well known in England, where he was for some time attached to the R.A.F. in charge of No. 2 Bomber Group, he will also be remembered for the "Goble and MacIntyre" flight round Australia in 1924 in a Fairey seaplane.

Air Marshal Sir Charles Burnett is 57. He is a former Director of Operations and Intelligence at the Air Ministry and Deputy Chief of Staff, 1931-1933, Air Officer Commanding the Irak Command, 1933-1935, and the Training Command, 1936-1939.



LEBENSRAUM: The Short Sunderland long-range flying boat (four Bristol Pegasus XXII engines) is the largest and most capacious machine in service. The type, the interior of which is illustrated above, has done magnificent service far out to sea. Sunderlands form the equipment of the first Australian squadron to operate with the R.A.F.

Casualties

THE Air Ministry, in their sixteenth communique, regrets to announce the following casualties on various dates:—

KILLED IN ACTION.—P/O. M. O. Howell (40538), L.A/C. W. Lilley (538024), Sgt. R. M. Perry (517007), Cpl. A. Sharp (522788), Sgt. J. Winn (566407).

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "KILLED IN ACTION."—Sgt. K. B. Crew (563071), Flt. Lt. A. A. Dilnot (37525), A/C.1 H. Dore (531093), F/O. D. F. Elliot (39075), P/O. J. R. Saunders (40145), A/C.1 D. L. Thomas (545990), A/C.1 A. Wilson (551660).

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED," NOW REPORTED "KILLED IN ACTION."—Sgt. J. Pearce (564932).

WOUNDED IN ACTION.—L.A/C. G. C. Balch (548758).

MISSING, BELIEVED KILLED IN ACTION.—Act. Sgt. R. Allon (580857), Cpl. T. G. Dodds (534038), A/C.2 W. J. Ellis (628712), L.A/C. T. Gibbin (550960), P/O. J. H. Grimes (41237), Flt. Sgt. J. E. K. Healey (562536), A/C.1 F. G. Hooker (547172), Sgt. H. Hulme (580342), A/C.2 F. J. Johnson (552464), Act. Sgt. G. E. F. Martin (580786), Act. Sgt. E. B. Morgan (580738), A/C.2 W. H. Pountain (618060), F/O. J. H. C. Speirs (39801), A/C.1 C. Watson (567346).

MISSING.—F/O. D. B. Allison (70769), Cpl. R. T. Black (567249), F/O. M. F. Briden (39706), A/C.2 A. G. Foster (621741), Act. Sqn. Ldr. A. J. Guthrie (34155), A/C.1 A. M. Hill (544752), Act. Sqn. Ldr. I. V. Hue-Williams (29210), P/O. E. F. Lines (36224), Sgt. F. M. Mason (580718), Sgt. B. J. Pickess (580809), Cpl. W. Robinson (535440), L.A/C. L. A. Stock (520962), Act. Sgt. M. B. Taylor (516752), Cpl. F. J. Taylor (533806), A/C.1 A. Telfer (531938), F/O. A. R. Vaughan-Williams (33293), A/C.2 C. Walker (627354).

KILLED ON ACTIVE SERVICE.—P/O. W. L. Colmer (52473), P/O. F. A. Connolly (40676), Act. P/O. P. C. Fraser (41839), Flt. Lt. F. Gower-Jones (22136), Act. Flt. Lt. E. J. Heatherington (39026), F/O. J. G. Howard (39526), A/C.1 E. H. Humphry (539268), Act. Sgt. T. R. Moss (518032), A/C.2 D. J. O'Regan (624786), Sgt. S. H. Potts (580464), L.A/C. J. T. Warriner (615941), P/O. S. M. Wickham (40773), Act. P/O. I. R. Wilson (42551).

*DIED ON ACTIVE SERVICE.—A/C.2 R. W. G. Hobart (640749), A/C.1 M. H. Molony (621703), L.A/C. F. G. Powell (525528), Temp. Sgt. G. R. W. Sage (351450), L/A.C. D. Selby (569377), A/C.2 H. J. Shinton (849216), A/C.2 S. C. Smith (861137), L.A/C. R. H. Willis (569344).

Royal Air Force Gazette

Royal Air Force

General Duties Branch.

The following are granted permanent commissions in the substantive ranks indicated and on the dates stated:—Squadron Leaders: (Aug. 1, 1939) P. H. Dutton; (Aug. 14, 1939) K. J. McKay. Flight Lieutenant: (July 28, 1939) H. B. Hurley (since promoted).

Flt. Sgt. J. Mitchell is granted a permanent commission as Pilot Officer on probation with effect from Nov. 26, 1939, with seniority of Sept. 27, 1939; Acting Pilot Officer on probation L. A. G. Howard is graded as Pilot Officer on probation March 1, 1938, and confirmed in his appointment May 3, 1938. (Substituted for notification in *Gazette* of July 26, 1938.) Acting Pilot Officer on probation A. J. Goldie is confirmed in his appointment with effect from Dec. 19, 1936, and graded as Pilot Officer with effect from Dec. 19, 1936, with seniority of Oct. 21, 1936. (Substituted for notification in *Gazette* of April 13, 1937.) Pilot Officer on probation J. L. Allen is confirmed in his appointment (Dec. 5, 1939).

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation on the dates stated:—(Sept. 30, 1939) I. F. McDermott, L. O. Rogers; (Dec. 6, 1939) D. H. B. Relton.

F/O. L. A. G. Howard is promoted to the rank of Flying Officer (Sept. 1, 1939). (Substituted for notification in *Gazette* of Nov. 21, 1939.)

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—(Nov. 10, 1939) G. Vivian, R. F. Aitken; (Dec. 27, 1939) J. F. Nicholson.

F/O. A. J. Goldie is promoted to the rank of Flying Officer (May 21, 1938). (Substituted for notification in *Gazette* of Aug. 23, 1938). F/O. J. J. K. Fleetwood is promoted to the rank of Flying Officer (July 11, 1939). (Substituted for notification in *Gazette* of Nov. 14, 1939). Air Comdre. M. Henderson, C.I.E., D.S.O., is granted the acting rank of Air Vice-Marshal (paid) (Oct. 26, 1939).

The following Flying Officers relinquish the acting rank of Flight Lieutenant on the dates stated:—(Aug. 27, 1939) R. W. Christmas; (Sept. 2, 1939) R. R. Holder, W. G. Moseby; (Sept. 3, 1939) P. F. Webster, J. McC. M. Hughes, F. M. C. Corelli, W. H. Biddell, J. C. Archer, M. C. Pearson, L. E. Abel, W. M. Penman; (Sept. 10, 1939) R. E. Craven; (Sept. 13, 1939) A. F. McGhie; (Sept. 14, 1939) W. C. G. Cogman, H. P. Pleasance; (Sept. 19, 1939) A. H. Siminson; (Sept. 22, 1939) G. H. Fielder, G. O. Mills; (Sept. 27, 1939) D. E. Gillam, A.F.C. (since promoted); (Oct. 1, 1939) H. G. Marriott; (Oct. 20, 1939) P. J. S. Shaughnessy; (Oct. 24, 1939) J. L. Atkinson; (Nov. 5, 1939) H. C. Sammels; (Nov. 6, 1939) R. S. Allen; (Nov. 9, 1939) M. C. Wells, F. E. W. Birchfield; (Nov. 11, 1939) D. B. Hobson; (Nov. 18, 1939) A. M. McKenzie.

The following Pilot Officers relinquish the acting rank of Flight Lieutenant on the dates stated:—(Sept. 3, 1939) R. G. Maddox; (Sept. 14, 1939) I. MacLeod Selkirk; (Sept. 15, 1939) G. O. Lister.

P/O. A. M. Cooper-Key takes rank and precedence as if his appointment as Pilot Officer bore date Oct. 4, 1939. Reduction to take effect from Dec. 6, 1939. Group Capt. R. P. Mills, C.B., M.C., A.F.C., reverts to the retired list with effect from Dec. 24, 1939, and resumes with effect from that date the rank of Air Vice-Marshal with seniority of July 1, 1933; the short service commission of Acting Pilot Officer on probation L. L. Pennington is terminated on cessation of duty (Dec. 27, 1939).

Equipment Branch.

The following Warrant Officers are granted permanent commissions as Flying Officers on probation with effect from Nov. 29, 1939, and with seniority of Sept. 18, 1939:—A. Hall, H. Allsopp.

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation (July 17, 1939):—K. E. W. Brace, B. L. Howell.

F/O. B. O. Cannon relinquishes the acting rank of Flight Lieutenant (Sept 8, 1939).

Accountant Branch

The following Pilot Officers on probation are confirmed in their appointments and promoted to the rank of Flying Officer (Nov. 28, 1939):—N. Adams, J. F. Roberts, J. E. S. Salter.

The following Flying Officers relinquish the acting rank of Flight Lieutenant on the dates stated:—(Sept. 3, 1939) H. R. Tredinnick; (Sept. 10, 1939) W. E. Wolsey; (Nov. 3, 1939) R. P. Bennett.

Medical Branch.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—(Oct. 5, 1939) J. St. C. Polson, M.B., Ch.B.; (Nov. 7, 1939 (seniority May 7, 1939) N. Hamlin, M.R.C.S., L.R.C.P., V. P. Geoghegan, M.B., Ch.B., M.R.C.S., L.R.C.P.; (Nov. 16, 1939) (seniority Nov. 16, 1939) R. C. Jackson, M.R.C.S., L.R.C.P.

Air Comdre. H. E. Whittingham, C.B.E., M.B., Ch.B., F.C.R.P.(E.), F.R.F.P.S.(G.), M.R.C.P.(Lond.), D.P.H., D.T.M. and H., K.H.P., is granted the acting rank of Air Vice-Marshal (paid) (Nov. 20, 1939); Flt. Lt. A. Sheehan, M.B., B.Ch., is placed on the retired list on account of ill-health (Dec. 2, 1939).

Commissioned Armament Officer

Warrant Officer L. Brown is granted a permanent commission as Flying Officer on probation with effect from Dec. 7 1939, and with seniority of June 19, 1939.

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS.

General Duties Branch.

Major F. J. Harington, D.S.O., is granted a commission in class CC as Flight Lieutenant (Hon. Squadron Leader) (April 1, 1939); Lt. H. Monro is granted a commission in class CC as Flight Lieutenant (July 26, 1939).

The following Pilot Officers are promoted to the rank of Flying Officer with effect from the dates stated: (April 12, 1939) H. L. Price; (June 7, 1939) N. G. F. Rose.

FLIGHT

IDENTIFICATION CHARTS

THOUSANDS of the wall cards issued by *Flight* enabling ready identification of German military aircraft are in use throughout the country. Embodying 72 drawings of sixteen principal types in various positions, the R.A.F., A.A. spotters and the Services generally, use them extensively. Incidentally, the drawings are copyright and may not be reproduced or re-copied without permission of the publishers in writing.

The chart, which measures 22½ in. by 14½ in. costs 1s., plus 6d. postage and packing on a single copy and 7d. on two copies.

Next week, a companion wall chart in the same style enabling ready recognition of the principal British military types of aircraft will be available from these offices at the same price.

Flt. Lt. I. L. O'Hare is transferred from the Equipment Branch with effect from April 17, 1939, and is granted the rank of Squadron Leader with effect from the same date and the acting rank of Wing Commander with effect from April 25, 1939; F/O. T. P. de Paravicini relinquishes his commission (Dec. 20, 1939); F/O. V. F. S. Dunton relinquishes his commission in class CC (Sept. 1, 1939).

The following relinquish their commissions in class CC on appointment to commissions in the Royal Air Force Volunteer Reserve (Sept. 1, 1939):—Squadron Leaders S. L. Delahay, J. S. Harrison (Squadron Leader Royal Air Force, Retired); Flt. Lt. (Hon. Sqn. Ldr.) F. J. Harington, D.S.O.; Flight Lieutenants E. W. Carmichael, S. J. Gilbert, H. Monro, O. D. Norwood; Flying Officers G. F. L. Coates, E. H. Roberts.

The notification in the *Gazette* of Oct. 27, 1939, concerning Flt. Lt. I. B. Beesley is cancelled.

Equipment Branch.

Maj. I. L. O'H. Hare (Indian Army, Retired) is granted a commission in class CC as Flight Lieutenant (Feb. 26, 1939); Maj. F. W. Whitaker (Royal Indian Army Service Corps, Retired) is granted a commission in class CC as Flight Lieutenant (April 15, 1939).

The following relinquish their commissions in class CC on appointment to commissions in the Royal Air Force Volunteer Reserve (Sept. 1, 1939): Flt. Lt. F. W. Whitaker; F/O. C. A. Adams.

Royal Air Force Volunteer Reserve

General Duties Branch.

The following Sergeants are granted commissions for the duration of hostilities as Pilot Officers on probation with effect from Dec. 1, 1939, and with seniority of the dates stated: (March 29, 1939) R. M. North; (Nov. 6, 1939) R. G. A. Barritt, P. V. Boot, F. J. Hartnell-Beavis, W. Walker; (Nov. 18, 1939) S. Christensen, R. T. Forgan, D. Henderson, P. Litchfield, T. C. P. Maxwell, R. A. Robertson, W. L. Rodger.

Sgt. E. D. Parker is granted a commission for five years as Pilot Officer on probation with effect from Dec. 1, 1939, and with seniority of March 29, 1939.

The following are granted commissions for the duration of hostilities in the ranks and on the dates stated:—Pilot Officers on probation: (Nov. 11, 1939) H. T. Grubb; (Dec. 19, 1939) H. J. V. Ashworth. Acting Pilot Officers on probation: (Dec. 10, 1939) W. A. H. Chapman, K. H. Potter, R. Scott, L. W. Simpson.

The following members of the Straits Settlements Volunteer Air Force are granted commissions for the duration of hostilities in the ranks stated with effect from Nov. 1, 1939, and with seniority of the dates stated:—Flight Lieutenant: (Sept. 14, 1939) T. J. L. Watkins. Flying Officers: (Sept. 14, 1939) J. A. Allen, S. J. Beattie, T. Carter, A. P. Craigie, T. A. D. Hewan, G. E. M. Jones, R. F. C. Markham; (Oct. 1, 1939) J. M. Hart; (Nov. 1, 1939) J. V. West. Pilot Officers: (Sept. 14, 1939) M Garden, A. T. Grieve; (Nov. 1, 1939) W. B. Dobree.

P/O. W. L. Lang is promoted to the rank of Flying Officer (July 9, 1939); Hon. Flt. Lt. C. R. L. Fitzgerald, D.S.O., relinquishes his hon. rank on cessation of duty Oct. 29, 1939).

EMPIRE DEFENCE: The Bristol Bolingbroke, one of the first pictures of which is shown above, is the Canadian version of the Blenheim and is being built by Fairchild Aircraft Ltd. in considerable numbers. It will be seen that it resembles the Blenheim IV The engines are two Mercury VIIIs.

Service Aviation

"Flight" photograph.

OVER THE NORTH SEA: One of the most popular and successful bombers ever to go into service is the Vickers Wellington which has already done magnificent work in the war. Two of these machines, which carry a very heavy bomb load and are armed with six machine guns, are seen nosing out over the North Sea.

Administrative and Special Duties Branch.

The following are granted commissions in the ranks stated with effect from Sept. 1, 1939, and with seniority of the dates stated:—Squadron Leader: (Jan. 31, 1939) Capt. S. L. Delahay (R.A.R.O.). Flight Lieutenants: (Nov. 23, 1937) C. A. Adams; (Sept. 1, 1938) Maj. S. J. Gilbert (T.A.R.O.); (July 8, 1939) Lt. O. D. Norwood (R.A.R.O.); (July 10, 1939) E. W. Carmichael; (Sept. 1, 1939) Lt. Cdr. R. A. Bell-Syer (R.N., Ret.).

Capt. J. W. Griffiths is granted a commission as Flight Lieutenant with effect from Sept 1, 1939, and with seniority of Dec. 19, 1935. (Substituted for notification in *Gazette* of Oct. 20, 1939); F/O. H. Buxton (R.A.F., Ret.) is granted a commission as Flight Lieutenant with effect from Sept. 1, 1939, and with seniority of Oct. 7, 1935. (Substituted for notification in *Gazette* of Oct. 20, 1939); Maj. F. J. Harington, D.S.O., is granted a commission as Flight Lieutenant (acting Squadron Leader (unpaid)) with effect from Sept. 1, 1939, and with seniority in the rank of Flight Lieutenant of Sept. 29, 1933; W. H. Calvert is granted a commission as Flight Lieutenant with effect from Sept. 1, 1939, and with seniority of July 3, 1939. (Substituted for notification in *Gazette* of Nov. 28, 1939).

The following are granted commissions as Flight Lieutenants with effect from Sept. 1, 1939, and with seniority of the dates stated: (Oct. 31, 1938) Sqn. Ldr. J. S. Harrison (R.A.F., Ret.); (July 26, 1939) Lt. H. Monro.

The following are granted commissions as Flying Officers: (Sept. 1, 1939) G. F. L. Coates, Lieut. E. H. Roberts (R.N.R., Ret.).

The following are granted commissions as Flying Officers for the duration of hostilities with effect from the dates stated: (Oct. 13, 1939) H. F. G. Dainty; (Oct. 31, 1939) G. Lund Lack; (Nov. 20, 1939) C. J. Lawrence; (Dec. 5, 1939) J. L. Scott.

The following are granted commissions for the duration of hostilities as Pilot Officers on probation on the dates stated: (Sept. 18, 1939) W. J. De Salis, D.S.C.; (Oct. 30, 1939) W. P. Stewart, D.S.O.; (Nov. 11, 1939) A. E. Dobson; (Nov. 20, 1939) I. McL. C. Power, F. H. Rolo, J. J. Stuart, E. M. Summers, M. S. Whitehouse; (Nov. 22, 1939) P. G. Clarabut; (Nov. 27, 1939) F. S. Adamson, E. V. Harrison; (Dec. 4, 1939) W. T. D. Windham; (Dec. 5, 1939) W. B. Mortimore; (Dec. 7, 1939) G. W. Futcher; (Dec. 11, 1939) C. J. Barnett, R. A. Davies, R. V. Mosse, E. H. M. O'Farrell; (Dec. 12, 1939) W. Barker, P. Fitzpatrick, T. B. Thomson; (Dec. 13, 1939) W. F. Jordan; (Dec. 14, 1939) A. W. Buck; (Dec. 15, 1939) J. W. L. Antill, H. L. Tudor; (Dec. 18, 1939) W. R. C. Hutchinson; (Dec. 22, 1939) B. Steel, M.C., R. H. Bennett, L. Cullis, G. Topholme, J. J. G. Clark, A. A. MacGregor, E. J. Ough, W. Wilson, E. A. Stockwell.

The following are granted hon. commissions in the rank of Pilot Officer (Dec. 22, 1939): J. W. D. Rowlandson, C. H. Spencer.

Pilot Officer on probation C. G. Gilbert is confirmed in his appointment and promoted to the rank of Flying Officer (April 17, 1939). (Substituted for notification in *Gazette* of Nov. 21, 1939.) F/O. V. F. S. Dunton is promoted to the rank of Flight Lieutenant (Sept. 1, 1939); Flt. Lt. A. H. S. Browne is transferred to the General Duties Branch (Nov. 6, 1939).

The following are transferred to the General Duties Branch (Oct. 30, 1939): Flt. Lt. I. P. Magrath, F/O. W. H. Carr-Birbeck, P/O. W. S. Fielding-Johnson.

The commission of Pilot Officer on probation R. G. Coates is terminated on cessation of duty (Dec. 22, 1939) (substituted for notification in the *Gazette* of Dec. 22, 1939); the notification in the *Gazette* of Oct. 27, 1939, concerning Flt. Lt. I. B. Beesley is cancelled; the notification in the *Gazette* of Dec. 19, 1939, concerning R. W. Potts is cancelled.

Equipment Branch.

Maj. F. W. Whitaker (R.I.A.S.C., Ret.) is granted a commission as Flight Lieutenant (Sept. 1, 1939); J. K. R. Howard is granted a commission for the duration of hostilities as Pilot Officer on probation (Sept. 14, 1939).

The following Acting Pilot Officers are graded as Pilot Officers on the dates stated: (April 19, 1939) R. Williamson; (May 17, 1939) R. L. Winterburn; (Sept. 3, 1939) H. L. E. Julyan, E. F. B. Markland, W. L. Rees, A. E. Savill, C. E. Jackson, E. G. Cooper, M. W. Fuller; (Sept. 5, 1939) L. N. Saw; (Sept. 8, 1939) R. V. Whittaker, S. C. Bucknall; (Sept. 20, 1939) T. W. C. Robinson; (Sept. 25, 1939) C. E. Plummer; (Oct. 18, 1939) R. G. Ashton.

Acting P/O. G. B. Howard-Rice is graded as Pilot Officer (Sept. 3, 1939). Substituted for notification in *Gazette* of Dec. 12, 1939.)

The following Pilot Officers are promoted to the rank of Flying Officers on the dates stated: (Oct. 12, 1939) W. K. Harris; (Oct. 26, 1939) S. P. Quick, J. B. Taylor; Nov. 3, 1939) B. S. Ottley; (Nov. 10, 1939) C. R. Mitchell, G. S. A. Ollis; (Nov. 17, 1939) H. W. Furness, D. L. King, L. W. Stotter, R. L. Winterburn; (Nov. 24, 1939) A. J. Sanford; (Nov. 30, 1939) J. P. Bennett; (Dec. 7, 1939) C. D. Biggs; (Dec. 14, 1939) D. A. Doughty; (Dec. 21, 1939) M. Bowles, J. Moorhouse, H. S. Wolff; (Dec. 29, 1939) M. V. J. De Fauque De Jonquieres, W. H. Hevecock.

The following Pilot Officers are promoted to the rank of Flying Officer (Nov. 30, 1939): S. G. Vickers, L. N. Bennett, W. E. Gower (substituted for notification in *Gazette* of Dec. 26, 1939).

The notification in the *Gazette* of Dec. 26, 1939, concerning Acting Pilot Officer on probation A. L. Scull is cancelled.

Accountant Branch.

Acting Pilot Officer on probation E. G. H. Downes is graded as Pilot Officer on probation (Dec. 5, 1939).

Medical Branch.

The following are granted commissions for the duration of hostilities as Flying Officers on the dates stated: (Dec. 1, 1939) C. Barton, M.B., B.Ch.; (Dec. 5, 1939) M. Hamilton, M.B., B.S., M.R.C.S., L.R.C.P.

Dental Branch.

The following are granted commissions for the duration of hostilities as Flying Officers: (Dec. 5, 1939) M. Anson, L.D.S., R. E. Morgan, L.D.S., A. N. Paul, L.D.S., E. C. Redfern, L.D.S., D.D.S., J. W. Rose, L.D.S., L. B. Somerville-Woodiwis, L.D.S.

Chaplains Branch.

The following are granted commissions for the duration of hostilities with the relative rank of Squadron Leader: (Dec. 11, 1939) The Rev. J. A. Crofts, the Rev. F. F. Davis, The Rev. J. E. Dixon, B.A., The Rev. J. Grudgeon, The Rev. J. A. H. Harlow, The Rev. E. B. Harthan, The Rev. J. Johnson, M.A., The Rev. A. G. C. Langford, B.A., The Rev. G. H. Martin, M.A., The Rev. D. C. Maule-Johnstone, B.A., The Rev. G. Mayfield, The Rev. J. C. Moran, The Rev. H. A. Morrison, The Rev. A. L. Poole, B.A., The Rev. H. C. Pugh, M.A., The Rev. C. J. Tucker, B.A., The Rev. H. J. R. Ulyatt, The Rev. R. L. G. Wright, M.A., The Rev. T. W. D. Wright.

Errata.

In the *Gazette* of Oct. 10, 1939, notification concerning Sgt. R. C. Parker, for 754182 read 754340; in the *Gazette* of Dec. 5, 1939, for T. B. Morgate read T. B. Norgate.

Auxiliary Air Force

Equipment Branch.

Flt. Lt. F. S. Piper relinquishes his commission (Nov. 11, 1939).

Erratum.

In the *Gazette* of Sept. 12, 1939, notification concerning F/O. E. A. Titley (A.A.F.R.O.), for 91063 read 90271 and for Aug. 14, 1939, read Aug. 1, 1939.

Women's Auxiliary Air Force.

The following are appointed Assistant Section Officers on the dates stated: (Dec. 15, 1939) Mrs. C. L. Boxshall, Miss A. Grant, Miss J. Mackay, Lady A. I. Seton, Mrs. F. M. G. Thomson, Mrs. A. A. Thorn; (Dec. 23, 1939) Cpl. Miss D. G. Chrystal, Sgt. Miss C. M. Cliff, A/C. 2nd Class Miss B. Gordon, Cpl. Miss I. M. Harrison, Sgt. Miss M. Hibbert, Sgt. Miss F. E. Redfern, A/C. 2nd Class Miss C. J. H. Stewart, Cpl. Miss P. H. Trubshawe, A/C. 2nd Class Miss M. C. M. Turner.

Erratum.

In the *Gazette* of Dec. 1, 1939, notification concerning Miss C. B. Clayton-Smith and Miss B. M. Wray, for Nov. 6, 1939, read Oct. 2, 1939.

General Duties Branch.

The following temporary promotions are made with effect from Jan. 1: Squadron Leaders to be Wing Commanders: G. H. Ambler, B. S. Thynne, I. R. Parker, Lord Willoughby de Broke, M.C.

Flight Lieutenants to be Squadron Leaders: R. J. Bushell, G. C. Pinkerton, P. Gifford

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

AIR OR LIQUID COOLED?

Some Suggestions

THE recent articles in *Flight* on liquid- and air-cooled engines by such eminent authorities as Mr. A. G. Elliott and Mr. A. H. R. Fedden, made absorbingly interesting reading.

After reading Mr. Elliott's contribution, one is more than ever convinced as to the merits of the liquid-cooled V-12 engine for installation in fighter aircraft. No other type lends itself so well to such an installation, all things considered. With these engines, speeds of fighters are likely to increase to 420 m.p.h. or more. About 1,500 b.h.p. will be necessary for such velocities, a typical engine might have the following particulars.

Bore and stroke: 6in.
Volume: 33.36 litres.
Power: 1,500 b.h.p. at 3,000 r.p.m. at 20,000 ft., 44.96 b.h.p. per litre.
Fuel: 100 octane No.

A "Speed Spitfire" powered by the above engine would certainly be much lighter than the new Vultee "Vanguard" as well as being slightly faster.

Most readers of *Flight*, who have been following closely the "War in the Air," are probably agreed as to the need for a really fast long-range twin-engined fighter to escort our bombers. Here again, the V-12 is ideal. Somewhat smaller engines would, of course, be used, having a very low frontal are. An example is given below:—

Bore and stroke: 5in.
Volume: 19.305 litres.
Power: 1,000 b.h.p. at 3,200 r.p.m. at 20,000ft., 51.81 b.h.p. per litre.
Fuel: 100 octane No.

The Rolls-Royce "Peregrine" probably develops more power than the 1,000 b.h.p. engine that I have suggested above when operating on 100 octane fuel. Certainly, it is the nearest approach to the ideal escort fighter motor. With a range of 1,600 miles, these machines are bound to make their presence felt ere the year is out. Speeds of these fighters are likely to be as high as 440 m.p.h.

It is only when we come to engines of 2,000 to 3,000 b.h.p. that we find the V-12 inadequate. The 24-cyl. H-type motor is almost certainly the optimum solution for this power category. The great difficulty of the X-type 24-cyl. engine, is that of running four connecting-rods on to one bearing, particularly is this so with short strokes. A master-rod with three link-rods suggests itself, but such an arrangement produces a lot of snags. There is far too great a difference between the cen. to cen. lengths of the master and link-rods, the stroke is increased too much on the banks at right-angles to the master bank, there is high angularity of the link-rods in certain positions, piston speed is erratic, balance of the engine as a whole is affected. The Allison is not an X-type engine. A long stroke would ease matters, but the engine would then become bulky.

For bombers in the 400 m.p.h. class, the H-24 liquid-cooled motor is ideal. What about this one?

Bore: 5¼in. Stroke: 5in.
Volume: 46.72 litres.
Power (take-off): 2,350 b.h.p. at 3,200 r.p.m., 50.3 b.h.p. per litre.
Fuel: 100 octane No.

The flying-boat constructor could certainly make use of two of these engines in a 24-ton boat with a range of 7,000 miles and a speed of 320 m.p.h.

Certainly, the evolution of the single-sleeve valve engine by the Bristol Co. is a tremendous achievement meriting the highest possible praise. Mr. Fedden and his associates have had to battle against great difficulties over a long period of time, their enthusiasm and tenacity is an example to all.

Mr. Fedden disagrees with Mr. Ronald Banks on the question of cooling very high-power engines. He says " . . . the problems involved are no greater than when liquid-cooling is employed." He mentions the H-type, among others, as being suitable for air-cooling. The problems involved are surely greater in the latter instance.

Let us compare the crankshafts of two engines of the same power and volume, i.e., 2,350 b.h.p. and 46.72 litres.

Shaft length: Liquid-cooled 39¼in. Inter-cyl. distance ¾in.
Shaft length: Air-cooled 52in. Inter-cyl. distance 3in.

The crankshafts of the air-cooled sleeve-valve engine would be double the weight of the liquid-cooled poppet valve one, due to the greater diameter of the journals and the fact that much less weight could be removed by drilling out. Peripheral speeds would go up, connecting-rods would be heavier, and so on.

Mr. Banks has stressed the desirability of pitching the cylinders of very powerful in-line engines as close together as is possible. No one will deny this. Below, I compare two engines, having the same bore and strokes, i.e., 5.5in. and 5in. respectively:—

Liquid-cooled p.v. H-type.	Air-cooled s.v. H-type.
No. of cyls.: 32.	No. of cyls.: 24.
Vol.: 62.29 litres.	Vol.: 46.72 litres.
Power: 3,130 b.h.p.	Power: 2,350 b.h.p.
Shaft len.: 51¾in.	Shaft len.: 52in.

The new Wright 42-cylinder multibank radial is to be a liquid-cooled job. The precise power of this new engine is not known, but the tremendous complication involved would hardly justify it for powers below 4,000 b.h.p.

What is the optimum layout for sleeve-valve engines of over 2,000 b.h.p., if air-cooling is to be considered?

I am scarcely in a position to answer this question, but here is one possibility:—

Engine type: Sleeve-valve, air-cooled, multibank radial.
No. of cyls.: 20.
Bore: 5¾in.
Stroke: 6in.
Volume: 51.063 litres.
Power: 2,400 b.h.p. at 3,000 r.p.m. (take-off).
Power per litre: 47 b.h.p.
Shaft length: 38in. (built up).

Complete cowling of this engine is possible, and bombers with two 20-cyl. multibanks would have a speed of more than 400 m.p.h. One of the greatest problems is that of a built-up crankshaft. I believe that Mr. Fedden did, at one time, design an engine of this type with O.H.C.

London, N.W.3. JOHN W. MORRISON.

THE NATURE OF ADHESION

Facts Inconsistent with Theory

WITH regard to Dr. de Bruyne's explanation of the why of gluing, I venture to ask how the theory of the author is able to explain the fact that "the polar liquid par excellence" (*i.e.*, water) gives so remarkably strong joints between "non-polar" adherents such as metals. Unfortunately for the safety of flying, this is actually the case, as the *adhesion of ice on metal aircraft* parts (even highly polished ones) proves.

In addition, one may mention that experience has not shown wooden aircraft surfaces to be more affected by adhering ice than metal ones.

Figures for the adhesive strength of frozen water between non-polar materials are published by A. M. Rothrock and R. F. Selden in N.A.C.A. Technical Note No. 723.[1]

Further, it might be mentioned that polar adhesives such as *urea formaldehyde* cements ("Kaurit") are successfully being used for joints between metal surfaces, for joints between metal and wood, for joints between metal and bakelite and between plastics of other kinds. This seems to me all inconsistent with the adhesion theory Dr. de Bruyne has brought forward.

According to German research work by Wilh. Kuech, done at the German Aeronautical Research Establishment (published in "Jahrbuch der Luftfahrforschung, 1938"), aminoplastics such as "Kaurit" are considered the most suitable adhesives for stressed joints between plastics. The strength figures given seem to contradict the theory of "polar" and "non-polar" adhesion.

The main point of the author is that wood and *overheated* wood have quite different gluing properties. That may be so, but I personally have never come across faulty gluing for which overheated plywood was to blame, nor have I heard of anybody else having an experience of this nature. I should say that properly manufactured bakelite-glued plywood will rarely be overheated. At the beginning of the manufacture of Tego-glued plywood, about 10 or 11 years ago, I saw samples of definitely overheated plywood which proved to be brittle, and this brittleness was caused by employing an excessively

(1) Adhesion of Ice in its relation to the de-icing of Aeroplanes (Aug. 1939).

high temperature during the pressing. To-day every manufacturer should know that an excessive temperature is as dangerous as a too low one, and faults of this nature should not occur with aircraft plywood.

I do not think that defective gluings with urea formaldehyde adhesives (Kaurit or Aerolite, for instance) are due to "polar" effects, overheated plywood or similar theoretical diseases, but simply to the *particularities* of these synthetic glues. Since 1935, I have had a certain experience with Kaurit. I have constructed some sailplanes, aeroplanes and aircraft parts, all stressed joints of which were made with this cement without the use of pins and woodscrews. The planes were flown and came not down in bits. In spite of this, the urea formaldehyde cement was found to be disappointing, and I returned for the time being to the use of casein glue. I understand that other aircraft constructors have done the same.

I will not say that the urea formaldehyde cement I used did not give strong joints, especially between plywood. But in order to obtain *reliable* gluing, so much more care and expense was involved that the glue had to be discarded in favour of casein. Exactly the same difficulties have been experienced after extensive use in the German aircraft industry. The research work by H. Klemm[2] and W. Kuech[3] should be quoted in this respect. It indicates that the use of *pure* urea formaldehyde cements for normal aircraft practice has been disappointing, and new ways (Klemm glue) will have to be found, if these glues are not to be discarded altogether.

One reason for this is that in order to obtain proper gluing the parts to be joined have to be far more accurately fitted to one another than would be required for normal glues such as casein. This is a nuisance, because it requires pattern-maker's work on simple aircraft parts which could be assembled by boys if the gluing were done with casein. Otherwise, small inaccuracies of the surfaces to be joined, unequal gluing pressures, unequal glue distributions, or traces of foreign bodies in the urea formaldehyde glue, will prevent a proper gluing, while casein will give in all these cases quite a satisfactory job. Further, special precautions have to be taken while using the synthetic cement, in comparison with the simple handling and the reliability of casein glue.

Dunstable. A. R. WEYL, A.F.R.Ae.S.,
Dart Aircraft, Ltd.

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(2) D.-Ing. Hanns Klemm, Neue Leim-Untersuchungen. Munich-Berlin, 1938.
(3) W. Kuech, Fortschritte auf den Gebiete der Kunstharz-Leimverfahren. "Luftwissen 1938," p. 427/431.

Dr. De Bruyne's Reply

I HAVE read Mr. Weyl's letter with great interest and would like to say that on the whole I think he and I are in less disagreement than his letter suggests.

The tests carried out here on adhesion between ice and metal showed that the strength of such joints was of the order of 200-300 lb./sq. in. Such joints are quite strong in the sense that it would need a fairly large force to dislodge the ice, but they are weak in comparison with the figures of the order of 1,000 lb./sq. in. obtained with wood. I do not think it safe to draw any conclusions from the general behaviour of wooden aircraft under ice-forming conditions since such aircraft are always painted or given some protective treatment.

The work of W. Küch is in agreement with results we ourselves obtained some time ago (Journ. Roy. Aeron. Soc., July, 1937, page 564). Using casein, methyl-methacrylate, and urea formaldehyde cements by far the best results were obtained with the urea formaldehyde cement *provided* that the surface was removed by etching so as to expose the (polar) fabric or paper reinforcement.

I can assure Mr. Weyl that the trouble due to overheating of plywood is a real one and quite independent of the inability of some urea formaldehyde glues to bridge gaps. I myself experienced it when repairing my Desouter aeroplane, and many other instances could be cited, though it would be impolitic to do so in a printed letter.

I am in full agreement with Mr. Weyl that a serious difficulty with most urea formaldehyde glues is their inability to make joints between surfaces that are not in good contact. We at Aero Research Limited, have worked hard to solve this problem and believe that the introduction of our G.B.9 hardener provides a remedy (on lines quite different from those suggested by the German workers cited by Mr. Weyl). I believe that G.B.9 hardener will give the aircraft industry those advantages of urea formaldehyde glues that have been so beneficial to furniture, sports goods and power boat manufacturers.

This, however, is rather outside the range of my article, which was concerned solely with the fundamentals of adhesion as a natural phenomenon. N. A. DE BRUYNE,
Duxford. Aero Research Limited.

EXHAUST EFFLUX PROPULSION

Yet Another Line of Approach

I HAVE read with interest Dr. Lanchester's series of articles on Exhaust Efflux Propulsion, and the criticisms of your correspondents. I agree with them that efficiencies greater than 100 per cent. are impossible, but neither they nor Dr. Lanchester seem to have derived the efficiency correctly. This will be seen, I think, from the analogy of the machine gun mounted on a moving platform (P.526).

If the gun is fired, then the energy expended per second will be $\frac{(m/s)\ v^2}{2}$ where v is the velocity of the bullets relative to the moving gun which is the datum.

When the gun is fired, however, the recoil will accelerate it from its present steady velocity; V_1, which is the datum, to a higher steady velocity: V_2. Hence the energy usefully employed per second will not be FV, but $F(V_2-V_1)$ and the efficiency will be

$$\frac{2\ (m/s\ v\ (V_2-V_1)}{(m/s)\ v^2} = \frac{2\ (V_2-V_1)}{v}$$

If the velocity of the aircraft is to remain constant, which is one of Dr. Lanchester's conditions, then the shaft h.p. required from the engine will be less when exhaust propulsion is used. If the normal velocity at this h.p. without exhaust propulsion be V_1 and the constant velocity V_2, the efficiency can be obtained from the above expression. In the case of a rocket, $V_1=0$ so efficiency is $\frac{2V}{v}$ as Dr. Lanchester has stated.

Yeovil. D. RAMSAY.

Dr. Lanchester's Reply

I HAVE read the above communication, but find it difficult to understand what Mr. Ramsay is driving at. If it be that he envisages some form of gun mounting which permits of, and absorbs, recoil independently of the platform on which the gun is mounted he is wandering from the conditions necessary to establish mechanical identity. I have no part in that.

The words which follow, I regret to say, in most part convey no meaning to me. For example (quoting): "When the gun is *fixed*, however, the recoil will accelerate it from its present steady velocity V_1 which is the datum, to a higher steady velocity V_2," etc. Considering that V is by hypothesis *constant*, this is rubbish. Yet it may be that Mr. Ramsay, by a roundabout way, is getting at the truth, or is on the way there. It is obvious that if in an aeroplane any auxiliary means of propulsion be supplied from any source whatever, the engine and screw propeller will be called upon to do less work if the velocity and the drag remain constant or (relaxing the latter condition) the load carried may be increased, or a little more latitude may be allowed on the score of parasitic resistance. These, however, are merely different ways in which the auxiliary means of propulsion may be turned to good account. It is possible that this is what Mr. Ramsay has vaguely in mind when he says, "then the shaft h.p. required from the engine will be less when exhaust propulsion is used."

F. W. LANCHESTER.

[It would appear that Dr. Lanchester has misread Mr. Ramsay's handwriting. In quoting, Dr. Lanchester says "when the gun is *fixed*, however," etc., and italicises the word. In Mr. Ramsay's letter the word is, so far as we can make out, *fired*, so that the sentence reads: "When the gun is fired, however . . . "

The correspondence concerning Dr. Lanchester's articles has shown that readers have taken great interest in them. We originally arranged with Dr. Lanchester that he should reply once only to any correspondence we might receive. However, the correspondence has been so voluminous that we have had to depart from that arrangement, and Dr. Lanchester has prepared a reply to Mr. Corbitt's last letter (see *Flight* of January 4, 1940).

In that reply Dr. Lanchester does more than answer Mr. Corbitt's argument. He gives a very valuable supplementary explanation, which will, we hope, serve to make the whole subject more "digestible." Lest readers of *Flight* should think that this whole discussion is merely of academic interest, we might, perhaps call attention to the fact that this is not so.

Dr. Lanchester pointed out, in his fourth article, that there is a very intimate relationship between the induction and the exhaust. In modern high-speed aircraft with supercharged engines, quite a considerable amount of power is consumed in speeding-up the air. Thus at least one phase of the problem is already of importance.—ED.]

THE INDUSTRY

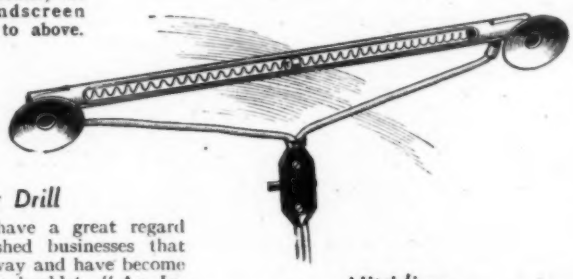
Seeing Your Way Clear

IN a country such as ours where the humidity of the atmosphere varies between sixty per cent. and saturation point, windscreen clarity is always difficult to maintain. The problem can be solved by admitting sufficient ventilation to keep both sides of the glass the same temperature, but this, while only a moderate discomfort to the motorist assumes unbearable proportions to aircraft crews operating at high speeds with the temperature well below zero mark.

Another way of avoiding condensation is to heat the screen locally and also the air close to it. The patent electric Screenclear demister and defroster has been designed to this end.

From the illustration it will be seen it is simply a small electric "fire," held in position by two suction discs, having a consumption of 3 amps at 12 volts. It is nicely and at the same time robustly made. The element is held at both ends but to avoid breakages due to vibration it is also steadied by a mica support in the middle of the outer casing. The casing itself is chromium-plated against corrosion. The Air Ministry has approved its use for aircraft and this, in itself, bestows a sort of hall mark on any apparatus.

The price is 17s. 6d. including switch and two-pin plugs. An adaptor costs a further 3s. The Screenclear is manufactured and supplied by C. R. Hopkins, 135, Kilmarnock Rd., Glasgow, S.1.



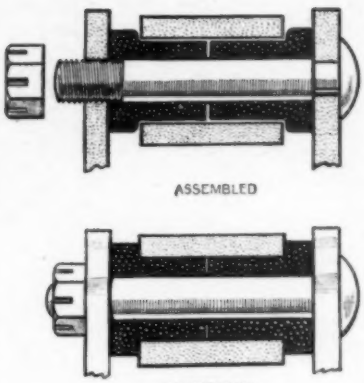
The Screenclear heater, the inexpensive windscreen demister referred to above.

Hair Drill

IN England we have a great regard for old-established businesses that started in a small way and have become world-famous. The booklet, "An Inventor met a Miller," is a brief history of the firm of Muller and Co. (England), Ltd., who started life making small screws, turned parts and other watch accessories sixty years ago at Soleure, in Switzerland. That small workshop has now developed into four large factories at Soleure, Selzach, St. Louis (France) and London. The growth makes a fascinating story.

To-day Mullers hold in stock no fewer than 3,500 master threads *up* to ½in. diameter and manufacture small drills ranging *downward* from 0.2in. to 0.0016in. The latter drill is finer than a hair.

The London address is Muller and Co. (England), Ltd., Sphinx Works, Chase Road, North Acton, N.W.10. Local representatives are also available all over the country.



Action of the Harris controlled bearing described below.

Flexible Bearings

MEMBERS of design staffs should make a point of obtaining from Howard Graham, Ltd., Tiddington Road, Stratford-on-Avon, the latest booklet dealing with operation, application and sizes of Harris controlled bearings and Torflex couplings.

The former are rubber bushings compounded and cured by new methods and "controlled" by the clamping of the end plates squeezing the bushing both radially and axially to a predetermined extent. It is claimed that the range of movement can be as much as 70 deg. each way from the normal position before creep occurs, but 30 deg. is the normal design limit.

Torflex couplings are for direct drives up 1¼in. diameter shafts, each shaft being gripped by a rubber bush enclosed in a threaded steel cap. Under load the tendency for these caps is to become screwed farther home on their opposite number. The fact that both shafts are, in effect, rubber-mounted, allows considerable mis-alignment.

Nitriding

THE case-hardening of special steels by nitrogen is the subject matter dealt with in a booklet issued by and obtainable from Nitralloy, Ltd., Norris Deakin Buildings, King Street, Sheffield, 3.

Nitriding, as most of our readers know, is the subjection of finish-machined parts, made of special steels, to the action of ammonia gas in an electric furnace at a temperature of 500 deg. Centrigrade for the time necessary to produce the required depth of case-hardening. The full period of ninety hours reaches a depth of 0.031in. The booklet covers most phases of the subject. Chapters are devoted to description, application, manufacturing methods and materials suppliers, the whole being profusely illustrated.

Fairey Meeting

THE chairman and managing director, Mr. C. R. Fairey, M.B.E., F.R.Ae.S., had some particularly interesting remarks to make at the eleventh ordinary general meeting of the Fairey Aviation Co., Ltd. Here are some extracts which do not require further comment since they are typical of the spirit and outlook of the British aircraft industry generally.

"Our industry, always intensely competitive, both technically and commercially, is now co-operating in the national interest. Design rights, trade secrets, and so forth, which in the past have been jealously guarded, are now being shared. Although we ourselves have always pursued an intensive and individual technical policy, directly war became imminent we intimated to the authorities our willingness to co-operate in every possible way and to build machines of any type that might be required, and are in fact about to build the products of another firm, while at the same time other companies are making aircraft to our designs.

"The response of the whole industry to the national demand upon it has been excellent, and with the assistance and co-operation of the authorities has resulted in a very satisfactory output. In fact, I would suggest that our highly competitive private industry has shown itself superior in efficiency, in ability to expand, and adaptability to any nationalised or semi-nationalised industry in the world.

"Despite present conditions we are still maintaining our foreign contacts, thereby keeping open some old connections and even making new ones, the extent of which I am not, of course, in a position to divulge.

"It is only left for me to say that whereas for the present the company is doing its utmost to meet the Air Ministry and national demands and will bend all its efforts to that end as long as the war persists, I can only express the hope that our next meeting will be held under different conditions and that in accordance with our consistent policy and the steps we are now taking we shall be successful in liquidating our present war commitments and facing a future in which our efforts, our technical experience, and equipment will be diverted to our proper work of the development of civil aviation, but that for as long as those same qualities are needed for national purposes they will be devoted to that end to the exclusion of every other."

The balance sheet showed the company to be in an extremely strong position. A further £100,000 transferred to general reserve increased that figure to £375,000 and £25,000 added to patents reserve brought that item to £145,000. Profit for the year ending September 30, 1939, amounted to £248,122 and a dividend of 12½ per cent. free of tax, was declared.

In view of the reduced profits and the necessity of increasing reserves the board did not recommend the payment of any bonus.

Rolls-Royce Interim

THE directors of Rolls-Royce, Ltd., have decided, owing to the unavoidable difficulty in arriving at the company's current earning position on Government contracts, not to declare an interim dividend at the present time. It is hoped to deal with the matter in the course of the early months of 1940.

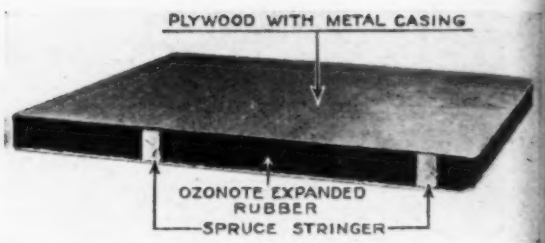
More Lightness

A new field in the production of a material wherein the lightness of expanded rubber can be used to the fullest extent, is now being explored by the Airscrew Co., Ltd., of Weybridge, Surrey.

As will be seen from the illustration, it consists of a multi-ply sandwich of expanded rubber or Ozonote, spruce stringers and plywood with a metal casing which, in addition to providing a considerable proportion of the strength, serves as an armour against damage by knocks. This last quality was clearly demonstrated to us by a fully grown man jumping from a desk on to a sheet laid on the floor, the landing being made heels first. The resultant damage was two very shallow dents.

Lightness and strength are not the only qualities. There is, in addition, no moisture absorption, and this makes it equally suitable for use in flying boats and seaplanes. A slight variant, where the casing is about $\frac{5}{16}$in. plywood and without exterior metal, is being extensively used for high-performance motor boat decks and coamings, enabling the centre of gravity to be kept low.

Quite apart from its physical properties, it is pleasant to the touch and is excellent for both sound- and vibration-proofing. Altogether a very useful new material with many applications.



A cross section of the Airscrew Company's new material showing the disposition of its various components.

Stainless Steels Chart

A WALL chart, this time dealing with non-corrodible aero steels including heat-resisting steels, has been issued by Firth-Vickers Stainless Steels, Ltd., Staybrite Works, Sheffield, 9.

Following customary practice, the chart is printed on both sides, one side showing the steels in groups according to their application, and on the other side the steels are in numerical specification order, separate columns showing their composition and mechanical properties. It is a companion to the aero steels chart issued recently.

Wheeling and Raising

UNDER their trade mark of Besco, F. J. Edwards, Ltd., Euston Road, London, N.W.1, have recently introduced an improved wheeling and raising machine known as the Type D Improved. The chief features about the machine are the swivelling head and special shape of gap to enable large and awkwardly shaped jobs to be dealt with.

The necessary pressure is applied by a handwheel under the bottom jaw; a quick-release lever facilitating the removal of finished work and ensuring the same working pressure on the insertion of a fresh sheet. All the rollers, both top and bottom (the machine is supplied with three bottom rollers) are fitted with ball bearings and have the added advantage of being adjustable for angle so that the pressure can be obtained at any particular part of the wheel required.

Of heavy construction (12¾ cwt. gross weight), the machine is quite rigid when in use and the flat back enables it to be attached either to the wall or to the back of a similar machine to give even greater stiffness. Important dimensions are: Depth of gap, 42in.; diameter by width of top roller, 9½in. by 3in.; diameter by width of bottom rollers, 3½in. by 3½in.; working height from ground, 48in.

Welding of Light Alloys

IN introducing the new Philips Industrial (Lanquepin) spot welding machines, a booklet has been produced setting out in concise form the methods used to obtain satisfactory spot welding of light alloys by the use of electrolytic condensers for energy storage.

The storage of energy in this way enables the machines to operate without demanding heavy peak power from the mains and avoids the difficulties usually arising from the connection of spot welding machines to the factory power supply. The system has the added advantage that the energy supplied to the weld can be measured very accurately. This is a valuable asset when spot welding aluminium alloys, and, for nickel alloys in particular, the ability to control the duration of the current discharge by altering the ratio between the capacity and inductance is of prime importance.

Charging of the condenser can take place at any speed, the voltage increasing to a stable maximum and using the peak voltage of the supply. The maximum power demand is thus dependent only on the frequency of the operation, the current consumption remaining the same. The employment of electrolytic condensers has been in use for some while, and experience is such that good results can be guaranteed. The booklet, which is called "Spot Welding of Light Alloys," is to be had from Philips Industrial (Philips Lamps, Ltd.), Century House, Shaftesbury Avenue, London, W.C.2.

Flealess Bags?

THE Services to-day are no more "featherbed" than they were in the days of roundshot, man-lifting kites and grappling-irons, but there is now available one comfort which must be a boon to any campaigner; a vermin-proof sleeping bag.

It is made from cushioning, 1in. thick, of foamed rubber whisked up into a resilient honeycomb: In other words, "Dunlopillo." It is covered in waterproof khaki drill and has a fluffy top lining of suede fabric with a zip-fastener operating half way down one side and a pillow of the same material on a hinge. The outfit weighs 15 lb. and straps up into quite a small parcel.

Apparently vermin will not live with Dunlopillo, but apart from that it is doubtful if there is another material which will give such comfort against damp and cold for the same weight. The makers are, of course, The Dunlop Rubber Co., Ltd., Fort Dunlop, Birmingham.

Back Again

AIRCO, LTD. and Interavia ask us to point out that they have reopened their old offices at 109, Jermyn Street, London, W.

Capital Increase

AIR DISPATCH, LTD., Tanglewood, Lisvane, Llanishen, Cardiff. The nominal capital has been increased by the addition of £9,900 in £1 ordinary shares beyond the registered capital of £100.

AERONAUTICAL PATENT SPECIFICATIONS

(*Published November 30, 1939.*)

12360. PETTERS, LTD., and SWAFFIELD, P. J. Starter motor arrangements for internal-combustion engines (513,973).

12367. SOC. SAVOISIENNE DE CONSTRUCTIONS ELECTRIQUES. Regulating and indicating apparatus for regulating the voltage of several transformers adapted to run in parallel (514,067).

12398. SINCLAIR, H., and CLERK, R. C. Synchronising couplings and variable-speed gearing (513,974).

12439. GARDNER & SONS, LTD., L., GARDNER, J. H. S., and GARDNER, J. R. Fuel-injection pumps for compression-ignition oil engines (514,011).

12602. MARTINDALE, A. F. Brake-operating means for vehicles (514,072).

24125. THORNTON, A. A. (Vickers, H. F.). Electric control systems (513,978).

24950. BORG & BECK CO., LTD. (Borg-Warner Corporation). Friction clutches (513,980).

26044. GOSS, T. G., and LONDON SPRING & FIBRE CO., LTD. Spring units for upholstery chairs, settees, and the like (513,933).

27835. CROSLEY RADIO CORPORATION. Push-button tuning-devices for radio receiving (514,026).

28908. HYDRAULIC BRAKE CO. Master cylinders for fluid-pressure braking systems (514,030).

34520. WILDE, P. R. DE, and KAUFMANN, C. Projectiles of small size (513,985).

1939.

5528. DAVIES, G. L., and WINTERMUTE, G. H. Radio landing-control system (514,080).

25849. AUTOMOTIVE PRODUCTS CO., LTD., and BROCK, D. T. Brakes for vehicles (513,937).

1937.

36047. RAISTRICK, H. Valves of the plug type (514,150).

1938.

8255. MARR, J. Signalling systems (514,154).

9318. TAMPIER, R. Control surfaces on aircraft (514,157).

9620. DUTFIELD, A. E., RAWLINGS, E. J., and RAWLINGS MANUFACTURING CO., LTD. Adjustable windows (514,161).

9995. TAMPIER, R. Aircraft (514,208).

10287. WESTLAND AIRCRAFT, LTD., RICHARDS, S. T. A., and DIGBY, F. J. W. W. Cooling devices in aircraft (514,209).

10721. SMITH & SONS (MOTOR ACCESSORIES), LTD., and MOSS, E. B. Indicators for the position of retractable undercarriages in aircraft (514,165).

12591. DE HAVILLAND AIRCRAFT CO., LTD., and THOMAS, F. M. Securing devices, particularly for such parts as aircraft cowlings and the like (514,119).

12764. SMITH & SONS (MOTOR ACCESSORIES), LTD., S., and MOSS, E. B. Fluid-pressure-operated apparatus primarily for use in aircraft (514,180).

12754. CLEVELAND, F. J. (Bendix Aviation Corporation). Radio loop-antennæ (514,176).

12789. BOSCH GES., R. Wireless receiving-apparatus (514,213).

12794. LIST, H. Apparatus for indicating oscillations (514,269).

12818. TWINCO, LTD., and LAUGHTON, G. A. Goggles, sun glasses and like protective devices (514,272).

12886. BIGGLESTON, H., LEGGETT, J. J., and BIGGLESTON, D. H. (trading as ELECTRIC STREET LIGHTING APPARATUS CO.), and WILMAN, D. Lighting fittings (514,276).